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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

NOVEMBER 18.

Institution of Welding Engineers:—Ordinary meeting at Birmingham. "Eye Protection during Welding Operations," Paper by R. R. Butler, M.Sc., F.I.C.

West of Scotland Iron and Steel Institute:—Ordinary meeting at Glasgow. "The Chemistry of a Firebrick," Paper by J. F. Hyslop, B.Sc.

NOVEMBER 30.

Institution of Welding Engineers:—Ordinary meeting at Manchester. "Flame Cutting by Hand and Machine." Paper by C. G. Bainbridge.

Institute of British Foundrymen.

NOVEMBER 19.

East Midlands Branch:—Ordinary meeting at Loughborough. "The Uses of Refractory Materials in the Foundry," Paper by J. G. A. Skerl, D.Sc.

NOVEMBER 22.

Birmingham and Coventry and West Midlands Branch:—Ordinary meeting at Coventry. "The Magnetic Moulding Machine," Paper by T. W. Bullock.

More of the New Patent Law.

The most important change in Patent Law that the Patent and Designs Act, 1932, which came into force on November 1, has brought into being is that the business man who desires to use patented machinery, materials or processes will be more certain than he has been in the past of the newness of the inventions for which he is asked to pay a contribution to the patentee. Prior to the new Act the only search backward made by the British Patent Office to see if claims made by an alleged inventor had been anticipated by others was into British patent specifications issued during the previous 50 years. It was not unknown, under those circumstances, for the Patent Office to grant Letters Patent on subject-matter which was known by the patentee, and sometimes by others, to be untenable if thrashed out in a court of law.

The new Act continues the search through old British patents and, additionally, authorises the Patent Office to refuse Letters Patent if it can show that the invention claimed has been sufficiently described in any document previously published, *i.e.*, made available to the public, in the United Kingdom. If the anticipating document is a foreign patent specification, it must not be older than 50 years. The Patent Office is not compelled by the Act to make an intensive search in this new field, but we may assume definitely that it will do so, as it now has the power. This innovation will raise the commercial value of future British patents to the previously higher level of those granted by Germany, U.S.A. and Austria. It is still of interest to remember in this connection that the test for novelty is not similar in all details in the several countries; also that in Germany a patent is, usually, unassailable after it has been five years in existence.

An increase of about 20 per cent. has been made to the total of renewal fees payable on a patent which runs its full course. Probably fewer applications for patents will survive the more intense examination for anticipation to which they will be put in future, so one may doubt if the Patent Office will suffer any increase of income by the increased fees. It is, however, a certain hardship on owners of already existing patents that they must pay higher renewal fees in future although the patents do not carry the hall mark of a world-wide search for anticipation.

The grounds on which a patent may be revoked in future are, for the first time, codified. Some of them are frequently overlooked by business men and patentees, although always in the mind of expert writers of specifications. A useful example to mention is that if, in addition to a complete specification fairly describing and ascertaining the nature of the invention it does not also sufficiently and clearly ascertain the scope of the monopoly claimed, it is liable to be cancelled.

A dilemma may sometimes occur through an apparent slip in one of the paragraphs codifying the grounds for revocation. A patent may be revoked, according to that paragraph, if it is for an invention relating to substances prepared or produced by chemical processes and if it includes claims which, under a certain other section, are disallowed. It has been the law for many years that valid claims in a specification shall remain valid notwithstanding the presence of invalid claims in the same patent. The paragraph in question is contrary to that principle. No instructions to a court are given in the paragraph as an alternative to revocation, so a patentee who is defending such an action and a judge who is deciding against some, only, of the claims in such a specification may have to show great ingenuity to avoid a conflict of principles. One solution would be for the patentee to amend his claims sufficiently before the action is heard; but how is he to do so if he is firmly of the opinion before the hearing that all his claims are valid? In other cases of proved invalidity of some of the claims of a specification the court orders amendments to delete the objectionable claims, and definite instructions for this to be done are contained in the Acts.

A valuable concession to inventors who desire to protect their inventions in certain other countries is offered in the new Act. It can occur that untoward events interpose themselves and prevent a British patentee from being able to fulfil formalities limited to time by the patent law of a foreign country in which he desires protection. This can happen under certain circumstances with a U.S.A. application. Under the new Act, the British Patent Office may delay as long as it considers necessary the sealing of a British patent where the earlier sealing would prove a hardship on the patentee. For example, the early sealing of a British patent would often defeat an application in the U.S.A. which was not made under the International Convention.

Another provision of the new Act which is an improvement over its forerunners is that a *bona-fide* patentee may more easily challenge that unscrupulous type of commercial man who attempts to frighten prospective customers of the patentee from purchasing his wares by insinuating that the patentee's patents are either invalid or an infringement of other patent rights. Under the new law it is not now necessary for the guilty party to be interested in the other patent rights,

XUM

or, in fact, in any patent at all, before he can be attacked; nor is it necessary that his offence be precisely a threat to launch an infringement action. This change will have a cleansing effect in a bad number of cases.

Two other interesting changes are that the period of provisional protection is increased from nine months to twelve, and that the normal period for acceptance of the complete specification is increased from fifteen to eighteen months. Both terms may be extended as before.

To sum up, the new Act is an excellent piece of legislature, of considerable value to both the patentee and the user of patents. It is arguable whether the Act might not also have contained a clause reciprocally imposing certain restrictions on Convention applications from abroad where the country of origin imposes limitations on the status of our Convention applications in its territory. Such a clause would have given us useful material with which to negotiate for mutual cancellation of the limitations.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

To the Editor of The Foundry Trade Journal.

Specifications for Castings.

Sir,—The Technical Committee of the Institute of British Foundrymen is engaged in a review of specifications for castings issued by various purchasers, with a view eventually to making recommendations which it is hoped will lead to standardisation of the requirements of purchasers with consequent benefit to both consumers and suppliers.

A large number of firms have already furnished copies of their specifications for the use of the committee, but before definite recommendation can be made, the committee would like to have before them copies of all specifications issued by private firms.

The committee therefore appeals to all issuers of specifications for castings—grey iron, steel, malleable iron and non-ferrous—to be good enough to forward a copy of each of their appropriate specifications to the committee for use in this work. All specifications forwarded will be treated in confidence, and may be sent to the undersigned or to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester.

Yours, etc.,

J. W. Gardom,
Convener, Technical Committee,
Institute of British Foundrymen.

39, St. Peter's Road,
Dunstable, Beds.
November 11, 1932.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers, in their Statistical Bulletin for September, state that the output of pig-iron in September at 260,400 tons was practically the same as in August, but represents a slightly higher daily rate; there was a net increase of two in the number of furnaces (59) blowing at the end of the month. Steel production in September amounted to 430,300 tons, an increase of nearly 70,000 tons compared with August, which was exceptionally low on account of the holiday period; the output in September, 1932, was some 30,000 tons higher than in September the previous year.

According to 150 firms employing 76,472 workpeople, the average weekly earnings per head in August amounted to £2 11s., compared with £2 13s. 6d. in July and £2 15s. 3d. in June.

Book Review.

Elementary Metallurgy for Engineers, by G. F. C. Gordon, M.A. Published by Constable & Company, Limited, 10 and 12, Orange Street, London, W.C.2. Price 8s. 6d. net.

The author opens with a chapter on testing, and, unfortunately, dismisses the testing of cast iron in 18 lines. "In repetition work," he says, "it is always possible to compile a tabular comparison between the results obtained from sample test-bars and from pieces cut from waster castings." Our experience tends to show that it is seldom that the usual tests are required from repetition castings. It is the heavier castings, which form the bulk of the engineers' requirements, that require testing, and as such deserve more space than the author has thought fit to accord to it. The author has included fatigue testing. Chapter II is devoted to metallography and macrography, and is wisely limited to two pages, for he returns to the subject in the next chapter, when covering the manufacture of iron and cast iron. The author's views on semi steel are, to say the least of it, curious. He points out that the introduction of steel will reduce sulphur and phosphorus, but makes no mention of the all-important silicon. Moreover, there is little justification for asserting that the cupola is incapable of melting wrought iron. If a crucible containing this material were placed in the hearth of a cupola between the tuyeres, surrounded by coke, and the cupola blown in the ordinary way, we suggest that the contents of the crucible would be melted. However, as the author indicates, it has little chance of doing this because of cementation. In this chapter the author wisely stresses the shrinkage of cast iron, as, certainly, engineers should be more familiar with its import. On page 43 the same trite advice to designers is given about the avoidance of right-angled corners. Owing to increased section across a corner, the ill-effects resulting from the technique of freezing is nullified, because of greater section, and fracture never or rarely occurs there.

Malleable ironfounders will view with alarm the statement on p. 45 that "malleable sockets, ties, elbows and bends are used extensively for joining steel *water and gas* pipes. They are dipped in rosin to fill up the blowholes." As much of this type of manufacture has been imported in the past it should give the British makers fresh hope. We consider that the author has insufficiently differentiated between white- and black-heart malleable. He certainly should have mentioned plating.

The next chapter takes in wrought iron, and in this connection reproduces two micros, which are perhaps a little too full of slag to be representative. Moreover, as with his other micros, no magnifications are given, which might give a wrong impression to the engineer.

Chapter V covers tool steel, and we suggest that his opening paragraph on page 57 should be replaced by a table giving the compositions—at least the carbon content—of a range of tool steels. In the next chapter, structural steels, the author includes the electric process, which we suggest belongs to the previous one so far as this country is concerned. His description of the most popular type is fundamentally wrong, whilst no mention is made of the high-frequency furnaces. In dealing with the baby Bessemer the author has insufficient grounds for saying its product is inferior in quality compared with steel from the electric furnaces. We would have liked to see real arguments put forth as to the advantages of the basic-Bessemer process, as engineers are at the present time searching for such information. To say that it will not consume its own scrap and that the process, because of speed, is difficult to control is insufficient in view of its excellent deep drawing properties. The balance of the book is devoted to forgings, alloy steels, heat-treatment, non-ferrous metals and the selection of materials. The ground covered by the author is extremely wide and difficult. He has our sympathy in choosing matter suitable for consumption by engineers. It is not so much what to say, as what to leave out. In general, the author has done extremely well, and the book has adequately accomplished its task. It it well indexed and admirably illustrated.

V. C. F.

Random Shots.

Here is good news for you! Mr. Badawl, ironmonger, High Street, Lower Camden, Bucks, has expressed the opinion that business is rapidly improving. In an interview he said: "I think the public is regaining confidence. People are beginning to feel that better times are ahead, and have started making long-delayed purchases. Only yesterday, Mrs. Grimme, the widow at No. 8, ordered a new dustbin and a set of household brushes. I take this as an indication that there will be a big boom in the ironmongery trade very soon."

* * *

The fact that yet another eminent business expert has made an optimistic prophecy lends colour to the belief that there is bound to be a change in trading conditions in the near future. With this assurance, readers can stop taking that bromide draft to send them off to sleep at nights.

* * *

One of "Marksman's" friends a short while back decided to sell a small engineering shop of which he was the owner. He came to "Marksman" for assistance in getting out a short announcement for insertion in the Press advertising columns, and together we evolved the necessary statement. But "Marksman" reflected at the time that it hardly made intriguing reading, and this prompted him to consider whether the style of this type of advertisement could not be brought into line with that of the West End property agents. The friend thought not, and wouldn't be persuaded. Ever is the path of the pioneer beset with obstacles!

* * *

Here, however, are one or two specimen announcements of "Foundry for Sale," which are somewhat unlike the usual run of things.

* * *

Foundryowner, reluctantly retiring from business, wishes to dispose of delightful nineteenth-century foundry. Substantial red-brick buildings, surrounded by pleasant plot of ten acres. Railway sidings, five minutes' walk; inn, one minute's walk. Production, when working to capacity, 150 tons per week. New equipment from reputable makers was installed only last week. Staff of twenty polite and efficient craftsmen. Whatever price you pay, you can be sure of getting more than you bargain for.

* * *

In the heart of industrial city, backing on to railway terminus, overshadowed by blast furnaces, sand quarry near back entrance, fine clientele two streets away, official receiver's office next door, no shareholder living within 850 miles; modern foundry for sale. All reasonable offers accepted.

* * *

More or Less.

Man wants but little here below
But when it comes to dress,
A look around will quickly show
That woman wants still less.

Marksman.

The Use of Fuel Oil in Foundries.*

By T. F. Unwin.

It is surprising the number of people who refer to fuel oil as crude oil. This is entirely a misnomer. Crude oil is the black sticky liquid of low flash-point which issues from oil wells, and is never marketed as such. It contains not only fuel oil but petrol, kerosene, gas oil, as well as paraffin wax or bitumen. These products are separated by distillation processes and the fuel oil sold in this country is an intermediate fraction from which all the lighter spirits which are volatile at ordinary temperatures, have been removed.

The Board of Trade require that fuel oil shall have a flash point over 150 deg. F. and in practice a safe margin is left and the product marketed has a flash point of about 200 deg. F.; it is not inflammable at ordinary temperatures and will not burn in the liquid state.

TABLE I.—*Cost of Heat Units in Various Fuels.*

Fuel.	Calarific value.	Cost per therm. (100,000 B.T.U.)	B.T.U. for 1d.	Calculated at
Electricity	3,413 B.T.U. per unit	14.65d.	6,826	½d. per unit.
Town gas	500 B.T.U. per cub. ft.	4.8d.	20,833	2s. per 1,000 cub. ft.
Fuel oil	19,000 B.T.U. per lb.	1.83d.	54,500	65s. per ton.
Producer gas	150 B.T.U. per cub. ft. ..	2d.	50,000	3d. per 1,000 cub. ft.
Coke oven gas	500 B.T.U. per cub. ft. ..	1.8d.	55,500	9d. per 1,000 cub. ft.
Coke	11,000 B.T.U. per lb.	1.46d.	68,400	30s. per ton.
Coal	13,500 B.T.U. per lb.	0.79d.	126,000	20s. per ton.

There are various grades of fuel oil sold to suit various requirements, these usually being specified by their viscosity, which is the measure of their fluidity or thickness. In this country the viscosity is measured on a Redwood instrument at 100 deg. F., and is the time taken for a given quantity of oil to pass through an orifice of standard size. Thus, 200-sec. fuel oil indicates that the viscosity of the oil when measured at 100 deg. F. on the Redwood No. 1 instrument is 200 sec. or 3 min. 20 sec. This oil is considerably thicker than the 70-sec. grade but lighter than one of 600-sec. viscosity.

A most important feature of all petroleum fuel oils which must always be taken into account in handling them is that the viscosity increases with fall in temperature; thus, the 200-sec. oil referred to has a viscosity at 100 deg. F. of 200 sec., but at 60 deg. F. its viscosity is about 750 sec. and at 140 deg. F. about 90 sec. The viscosity curves of various fuel oils vary in character according to the origin of the oil, as is shown in Fig. 1. Another feature of the specification of fuel oil is the setting point or the temperature at which the oil becomes solid. These vary considerably with different oils and are not dependent upon the character of the viscosity curve.

An average chemical analysis of fuel oil gives the following results:—Carbon, 85.5 per cent.; hydrogen, 12.5; sulphur, 1.5; and oxygen, nitrogen, ash, etc., 0.5 per cent. The most important feature, however, is the calorific value, which is high, being about 19,000 B.T.U. per lb. and which only varies within small limits even over widely differing grades of oil. When purchasing liquid fuel, therefore, one can always know that the number of heat units in each ton will be practically the same over long periods.

The oil companies have storage refining and blending installations at strategic points all round the coasts, whence supplies are distributed and delivered to users' premises in rail-cars, tank barges or road wagons. Storage tanks are installed by the consumer, to hold an adequate supply of oil to suit the consumption, and the oil is distributed from these tanks to the plant.

The question of the fuel to use for a given heating operation is one which needs very close consideration. Since the war the great strides made by our metallurgists in the science of materials have made it essential for the heating operations carried out either in the manufacture or preparation of metals and alloys, to be placed on a scientific basis. In order to obtain the exacting conditions now required, fuels which can be closely and, if desired, automatically controlled have become essential not only as regards the amount of heat evolved and the exact distribution of it, but as regards control of furnace atmosphere, etc., all in conjunction with the lowest running cost and healthy workshop conditions. To meet modern requirements, therefore, not only must there be the heat units in the fuel at the lowest possible cost, but there must also be what may be termed a controllable fuel.

From Table I it will be seen that the cheapest source of B.T.U. in this country is in coal, and to a lesser extent coke, but these fuels have been found wanting in the important requirement of controllability and for modern furnace work are, therefore, giving place to one of the other heating agents—gas, oil or electricity. Further, it will be seen that among these heat units are available in fuel oil at a similar price to coke-oven or producer gas, but much more cheaply than in either manufactured town gas or electricity.

Burners.

Fuel oil not being inflammable in its normal state at ordinary temperatures to produce a flame, some apparatus has to be provided to split up the liquid fuel oil into as fine a state of division as possible, and to mix this pulverised oil intimately with the quantity of air required for complete combustion. This is the function of the oil burner, of which there are very many types and makes. The breaking up of the oil into a mist requires some form of energy, and burners utilise any of the following agents for atomising purposes:—Low, medium or high-pressure air, steam or pressure on the oil itself. As far as industrial furnaces are concerned, steam-jet and pressure-jet burners are hardly ever used, the various types of air-jet burners having been found most suitable for the applications concerned.

Low-pressure air burners are classified as those employing air supplied by a fan at pressures up to about 28 in. w.g.; medium-pressure air burners operate on air at a pressure of from 1 to 5 lbs. per sq. in. (usually 2½ lbs. to 3 lbs.), the air being supplied by a positive blower; the high-pressure burner includes all those requiring an actual compressor for providing the air, and run at any pressure higher than 5 lbs. per sq. in.

The low-pressure air burner has enjoyed wide popularity for many years on account of its simplicity and the cheapness and low running cost of the blowing fan required. With the exception of a few high-pressure burners, the vast majority of burners for furnace work were of the low-pressure type. This type had disadvantages, however, which have become more crystallised during the last few years, and as a result the medium-pressure burner has come rapidly into favour for many purposes. The low-pressure burner normally requires 50 per cent. or more of the total air necessary for combustion, to be passed through the burner for atomising the oil, though in a few cases of the best types good results can be obtained on less than this amount, a minimum quantity being about 25 per cent. The air passed through an oil burner cannot be preheated above about 200 deg. C. owing to the possibility of damaging the burner, and therefore in any furnace where highly-preheated air is to be used for fuel economy the use of a low-pressure air burner limits the quantity of air which can be so preheated to the percentage not required for atomisation, which in turn limits the possible economy, and is, therefore, objectionable.

Medium-pressure burners, owing to the greater energy contained in the air at higher pressures, can be designed to atomise the oil on 5 per cent. of the total air for combustion, and if such a burner is used, it will be clear that 95 per cent. of the air can be preheated to as high a temperature as is possible. The same remarks apply to high-pressure burners, and either medium- or high-pressure burners are therefore always used on recuperative or regenerative furnaces. With a low-pressure burner again, it is difficult to run on very low oil-consumptions, the limit of efficiency being 1 to 1½ galls. per hr. Medium-pressure burners will, however, produce tiny flames using down to one-third of a gall. or some 3 lbs. of oil per hr. only.

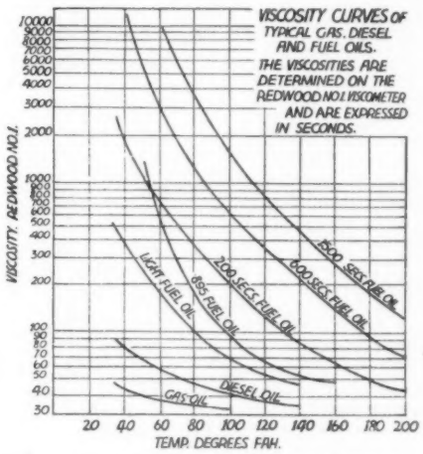

FIG. 1.—VISCOSITY CURVES OF VARIOUS FUEL OILS.

There is another factor involved, and that is the length of flame produced on a given oil consumption. The old types of low-pressure burners, owing to the comparatively poor atomisation were conspicuous by long lengths of combustion space required, and the tendency to form carbon on the end of the combustion chamber opposite the burner. This is, of course, a question of burner design, and recently improved low-pressure burners have been invented, which obviate this difficulty and enable a short flame to be obtained, but the introduction of the medium-pressure air burners at once showed a way out of the trouble. With the greater energy in medium-pressure air, the designer has more scope and a greater margin of safety.

In view of these considerations medium-pressure burners are, in modern practice, generally used in the following conditions:—(1) where small flames are required using under 1 gall. of oil per hr.; (2) in all recuperative and regenera-

* A Paper read before the London Branch of the Institute of British Foundrymen. Mr. V. C. Faulkner presiding.

tive furnaces where air is preheated over 200 deg. C.; (3) where short flames are required in a limited combustion space, particularly as regards length; and (4) where fuel oils of comparatively high viscosity are to be used and oil-heating facilities are defective. High-pressure burners using compressors are usually to be found in regenerative furnaces where the absolute minimum quantity of cold air must be used for atomisation. They are also used in portable-burner plants, where no assistance in vapourising the oil can be obtained from a hot-combustion chamber, burner block, etc. In the remaining cases well-designed, low-pressure burners are satisfactory.

A modern oil burner operates without smoke even at starting up, and without any carbon formation in the combustion chamber at any time. It should be easily lit by means of a taper or plain gas jet.

A warning against considering the merits or otherwise of any oil burner as such without taking into consideration the design of the furnace to which it is applied seems desirable. If the best results are to be obtained, the heating unit must be taken as a whole and the burner, though a very important component, is only a part of the problem. Reverting now to the question of the application of the cheap heat units in oil to foundry processes, the thermal efficiency of furnaces varies, of course, widely, but as a general rule in modern practice oil-fired and gas-fired furnaces will give a thermal efficiency of 25 to 50 per cent. and electric furnaces 60 to 80 per cent. Interpreted in terms of heating cost, this means that with electricity at ½d. per unit, each therm of heat applied to the stock at 75 per cent. efficiency, costs approximately 1s. 6d. With gas at 1s. 9d. per 1,000 cub. ft., each therm applied at 33 per cent. efficiency costs rather over 1s., whilst with oil at 65s. per ton, each therm applied at 33 per cent. efficiency will cost roughly 5.8d. The present cost of heat in oil fuel is about 2d. per therm, which is roughly equivalent to town gas at 10d. per 1,000 cub. ft. and to electricity at 0.07d. per unit. This is, of course, only a rough guide, as efficiencies vary on different processes and there are many cases where, for special reasons, it may only be possible to use one particular fuel for the process concerned.

As regards furnace efficiencies, actual electrical efficiencies have already reached the attainable limit, whereas the technique of gas and oil furnace combustion, particularly the latter, is still in its infancy, and considerable improvements will undoubtedly take place as time goes on. Developments in refractory materials, recuperative devices, better burners and control methods, etc., have already rendered possible a much more efficient use of the heat developed in combustion than was practicable a short time ago, and this process is still going on. Even such elementary precautions as the use of insulating material on oil-fired furnaces is a comparatively recent introduction, but there is no reason why an oil furnace should not be insulated just as effectively as an electric furnace, with corresponding saving in heat losses by radiation. The heat transferred to the material is better in a furnace using a fuel than in an electric furnace, as in the latter case heating is by radiation only, whereas, when passing hot gases among the stock, the heating takes place by convection as well as radiation.

Non-Ferrous Metal Melting.

The use of oil fuel for melting non-ferrous metals has increased to a considerable extent during the last few years; the reason for this may be sought in the greatly increased outputs obtainable from small units, and low melting cost combined with consistent quality of metal and the general improvement in working conditions due to the absence of ashes, fumes, etc., inseparable from coke-fired furnaces. The old method of carrying out melting operations was with pit fires, the metal being contained in a crucible which was placed on a coke fire below ground level. The disadvantages of this method were many; labour conditions were very arduous, the men having to work over a hot fire giving off products of combustion containing a considerable amount of carbon monoxide. The output per furnace was strictly limited, and the output for a given floor space low. Metal was often spilt, and the ashes had to be treated for the recovery of this spilt metal. The crucible costs were high, as were the labour costs, and valuable space had to be set apart for the storage of fuel and for ash dumps. The only advantages of this method were the low initial cost of plant and its suitability for cases where small quantities of different alloys were required. In the case of large charges of metal, coal-fired reverberatory furnaces have been the standard practice.

Table II.—*Stein Quick Working Oscillating Melting Furnace Test Results on Iron.*

Date of heat.	Charges. Cold additions	Charges. Liquid metal.		Charges. Total.	Time for superheating.	Outlet temperature of metal in tapping spout.	Fuel consumption.			Superheat. deg. C.
	Weight lbs.	Weight lbs.	Temp. deg. C.	Weight lbs.	Mins.		Galls.	Lbs.	Per cent by weight of the charge.	
30/1/32	221	3,090	1,262	3,311	40	1,563	20.3	191	5.86	301
	221	3,090	1,342	3,311	60	1,635	21.6	203	6.1	293
1/2/32	221	3,090	1,331	1,552	45	1,590	16.1	152	4.6	359
	126	2,210	1,219	1,345	34	1,563	16·1	152	6.5	344
2/2/32	221	3,090	1,214	3,311	50	1,630	25.6	240	7.2	416
	221	3,090	1,320	3,311	50	1,655	25.8	242	7.2	335
3/2/32	55	3,310	1,235	3,365	45	1,615	28.7	270	8.1	380
	55	3,310	1,275	3,365	40	1,645	26.7	251	7.5	370
4/2/32	55	3,310	1,200	3,365	45	1,605	26.0	244	7.4	05
	221	3,090	1,250	3,113	40	1,625	21.1	198	6.0	75

For preheating the furnace before the two heats each day, 15.4 galls. of oil were used per day, and this preliminary operation lasted 50 mins.

Oil-Fired Crucible Furnaces.

Developments have proceeded along two distinct channels. For instance, the crucible furnace has been improved by the use of tilting mechanism, the crucible being fixed in a casing which serves also as a combustion chamber, and coke has been replaced by oil. The change of fuel has resulted in the following advantages: Owing to the facility with which an oil burner is lit up from cold, and the steady heat which is provided in all conditions, there is none of the periodic drops in temperature which occur when coke furnaces have to be re-coked or clinkered. The melting time is therefore reduced, the output increased, and the furnace operators can be certain of obtaining the required temperature in a given time. There is practically no loss of metal, the working conditions have been immeasurably improved, and the cost reduced. In addition, the fuel oil can be stored in any space not required for other purposes, and ground space for coal and ash dumps set free for other more useful purposes.

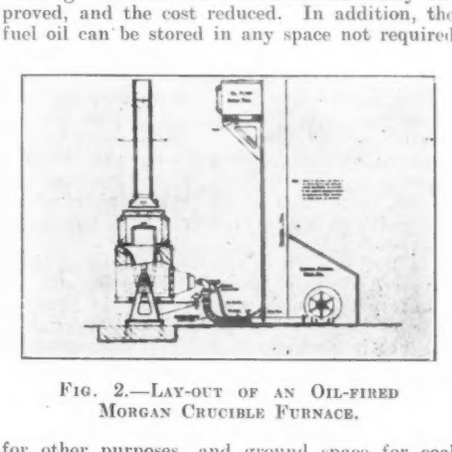

Fig. 2.—Lay-out of an Oil-fired Morgan Crucible Furnace.

It will also be appreciated that an oil burner when once lit up and set, produces the required amount of heat entirely unattended, so that the difficulties experienced in keeping a coke fire in proper condition are obviated. It is often found that the cost of labour for melting operations is reduced by 50 per cent. with oil fuel, as compared with coke, as one furnaceman can look after several units with ease. There is no cartage of fuel or ashes, and no ashes to be treated for the recovery of spilt metal.

These oil furnaces can also be built in much larger sizes than can be satisfactorily heated with solid fuel, and are now manufactured in sizes from 60 lbs. to 1 ton, brass capacity. The oil consumptions are generally as follow:—

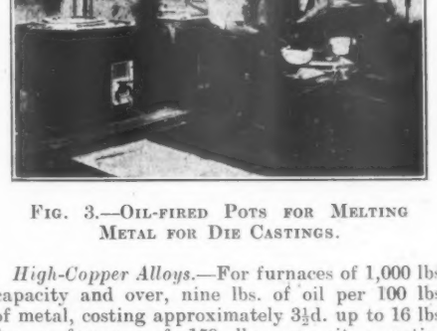

Fig. 3.—Oil-fired Pots for Melting Metal for Die Castings.

High-Copper Alloys.—For furnaces of 1,000 lbs. capacity and over, nine lbs. of oil per 100 lbs. of metal, costing approximately 3½d. up to 16 lbs. for a furnace of 150 lbs. capacity, costing about 6d.

Yellow Brass.—Eight lbs. on the large sizes, rising to 14 lbs. on the smallest.

Aluminium.—Eleven or 12 lbs. on the large size, rising to 19 lbs. on the smallest.

As regards melting times, the number of melts per shift of 8 hrs. varies with the size of furnace, but with bronze and gun-metal, 4 heats (representing 6,720 lbs. of metal) can be made from the ¾-ton size, and 6 heats (representing 3,900 lbs. of metal) from the 600 lbs. size. In the case of aluminium, the times per melt are naturally much lower, owing to the lightness of the metal, and the total quantity melted is not so great. On a ¾-ton size, 8 melts per shift (representing 4,480 lbs. of metal) can be obtained,

whilst on the 400 lbs. size, 11 melts (representing 1,650 lbs. of metal) are obtainable. Crucibles have also been greatly improved, and costs on this item correspondingly lowered. A good crucible should now give 80 to 100 heats if properly used.

In addition to the tilting units, fixed oil-fired crucible furnaces are also used in many works where small charges are to be melted. In these cases the ease of starting and stopping and the regular temperature obtainable are very useful, particularly where a sensitive metal, such as aluminium, is concerned, which has to

Fig. 4.—The Sklenar Midget Furnace.

be poured at a specific temperature. A particular type of metal pot is the aluminium maintaining pot, which is widely used in all aluminium casting works for maintaining the temperature of the metal at the required degree after melting; these are, in most cases, oil fired, the consumption being in the neighbourhood of 1 gall. per hr. only.

On a recently-installed melting and maintaining pot plant, the overall cost with town gas was 0.725d. per lb. of finished castings made, but when converted to oil, using Urquhart burners, the cost was 0.171d. per lb., a reduction of 76 per cent., the conditions in each case being identical. Crucible furnaces are normally used in all cases where valuable metals are concerned, as the loss must then be kept to the lowest level, and where any large proportion of the constituents of the alloy are volatile, such as in 60/40 brass, also where the metal is liable to porosity troubles in casting owing to gas occlusion, etc.

Fig. 2 shows a diagram of a typical oil-fired tilting crucible furnace, tilting about an axis through the centre. It is constructed in six sizes, ranging from 150 lbs. to ½-ton brass capacity. The furnace body is self-balanced, and the tilting and pour controlled by hand by means of the worm and bevel gear. The oil burner is of the Morgan low-pressure air pattern, mounted separately from the furnace, the oil being controlled by a needle valve.

Sklenar Furnaces.

The other line of development has been in the direction of open-flame furnaces, either of the barrel type or of the reverberatory pattern. The Sklenar type of furnace, one of which is shown in Fig. 4, is made in three standard sizes of 160, 300 and 660 lbs. brass capacity. The oil burner, which is of the Wallsend low-pressure air pattern, is inclined slightly downwards, the flame passing over the surface of the bath of metal and the products of combustion then passing under a low arch and up the vent, which is fairly large and is arranged so that the charge of metal can be loaded into the top of it and be preheated by the hot gases as it falls down into the bath at the bottom. A pipe recuperator is also provided in this passage through which the air from the fan passes on its way to the burner, thus becoming preheated to about 200 deg. F.

Some remarkably high outputs have been obtained with these types of furnaces. In one engineering works a Sklenar Midget furnace of 300 lbs. capacity was lit up at 8.20 a.m. and melted 16 charges of 320 lbs. of various copper scrap and ingots, etc., by 6.10 p.m., when the installation was shut down. The total oil consumption on this duty was 44 galls. for 5,120 lbs. of metal or 7.8 lbs. of oil per 100 lbs. of metal melted, costing about 3d. It is interesting to observe that a furnace to do this duty occupies a floor space of under 3 sq. yds.

There is a considerable number of these furnaces operating in all parts of the country, handling chiefly bronze and gunmetals and in some cases aluminium alloys. The oil consumption, generally speaking, is under 1 gall. of oil per 100 lbs. melted, and it will be appreciated from the high outputs referred to above that the labour and other operating charges are reduced to a minimum.

Armstrong Furnaces.

The barrel type of furnace shown in Fig. 5 has been developed by Sir W. G. Armstrong Whitworth & Company, Limited, and is made in two sizes of 350 and 1,000 lbs. brass capacity. The shell of the furnace is shaped like a barrel and mounted on rollers, the furnace being tilted by means of the large circular handle at one end. The body is so constructed as to enable the top half to be swung clear, thereby exposing the inner lining. The lining of this furnace is noteworthy, being of plastic refractory material which is rammed in between the furnace shell and a former, which is part of the furnace equipment. The furnace is carefully fired up before using in order to produce a glazed surface on the lining, which is then quite smooth all over. Two low-pressure air-oil burners with micrometer adjustment are provided, one at each end firing along the central axis of the furnace.

Some interesting results obtained with these furnaces are as follow:—On one melting aluminium alloys, 6-cwt. charges are melted in 30 min. on an oil consumption of 8 per cent. by weight to metal melted, costing about 3d. The number of heats per day is 12 to 13, giving an output of 18 tons per week, and the total metal loss is 2.5 per cent. This furnace has carried out 3,600 heats, melting approximately 800 tons of aluminium alloy, and the original lining was still in use when these figures were taken after two years' operation.

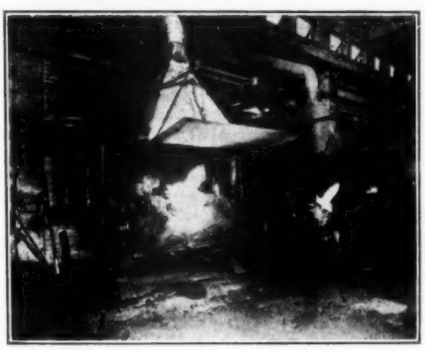

Fig. 5.—Armstrong Oil-fired Rotary Furnaces.

When melting bronzes and brasses, the fuel oil consumption is about 9 per cent. by weight and the time of melting 3 cwts. charges 35 to 50 minutes. The lining, when melting these metals, gives approximately 500 heats, but one installation has obtained 1,000 heats.

Selas Furnaces.

Another type of metal-melting furnace developed by the Selas Gas & Engineering Company is shown in Fig. 6. It is of 350 lbs. capacity and is being used satisfactorily for the melting of aluminium alloys. In this case one low-pressure air burner is fitted firing at right angles to the axis of the furnace, a rolling flame being thus produced from one end of the furnace to the other, and a very satisfactory scrubbing of the flame along the metal surface is obtained. One of these furnaces, melting aluminium alloys at 950 deg. C., produces a charge of 3 cwts. each 45 minutes on a consumption of 1 gall. of fuel oil per cwt. of metal melted, or 8 per cent. by weight. The furnaces are lined with Sillimanite.

Melting of Iron.

The standard method of melting iron for casting has for many years been the cupola using

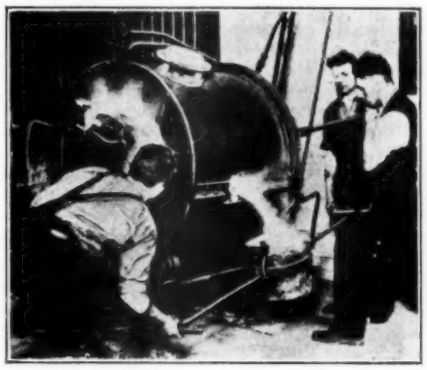

Fig. 6.—Selas Oil-fired Furnace for melting Light Alloys.

coke, and for ordinary metal this method is satisfactory and cheap. Quite recently, however, a considerable demand has arisen for special irons for various purposes, and in the manufacture of these, difficulties have arisen in the mixing operations when special metals, such as chromium, nickel, etc., are introduced and the carbon content has at the same time to be maintained at a specific amount. In order to produce these special irons satisfactorily, and to control the pouring temperature accurately, a special furnace is necessary, and to meet the demand where quantities up to 2 tons are dealt with, a recuperative oil-fired furnace of the drum type with mechanical oscillation has been produced, and is giving excellent results.

This Stein furnace is manufactured in four sizes, with capacities of ½, 1, 1½ and 2 tons. It consists of a sheet-iron cylinder closed at both ends by two conical pieces of plate, all welded solid. The oscillator movement takes place on four rollers, of which two are driving rollers operated electrically through a speed-reducing gear. Suitable switchgear is arranged so that the furnace may either be maintained in oscillation automatically, or may be tilted by a suitable push-button control on the tilting motor. The interior of the cylindrical shell is lined with special refractory material rammed in place round the centre. This rammed material is considerably better for a furnace of this nature than brick lining, as it is less permeable by the metal and slag as well as being cheaper. A special type of low-pressure air-burner is fitted, the burner receiving the greater part of the hot air coming from the recuperator, which is built separate to the furnace shell. The heat transfer from the flame is facilitated by a special arrangement of the burner block and the conical prechamber of the furnace. In the burner block, a blast pipe carries some of the hot air from the recuperator under a considerable pressure and injects it tangentially at the apex of the cone. This jet of air causes great turbulence in the furnace and a rapid rotary motion of the flame, giving perfect mixing of the air and oil and an excellent wipe off of heat from the flame on to the walls of the furnace. The waste gases are collected on leaving the furnace into a vent pipe lined with refractory material, pass thence into the waste gas flue, at the other end of which is arranged a brickwork setting in which a

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metallic-pipe recuperator is arranged for heating the combustion air by means of the waste gases.

Owing to the method of transmitting the heat, the oscillating furnace renders it possible to obtain the highest efficiency. When working, the refractory lining is highly heated, and due to the oscillating movement, is constantly moving underneath the metal being melted and transfers its heat to the latter.

The process of melting is carried out to a large extent indirectly by direct transmission of heat by conduction. For this reason it is no longer necessary to tap off the slag lying on the surface of the bath as in the case of the reverberatory furnace where this troublesome operation is essential in order that the gases should heat the metal directly while it is being melted. The slag remaining on the bath protects the surface of the metal and reduces the melting loss to the same figure as is obtained with crucible melting. It is possible, with this furnace, to obtain irons of accurate composition with regularity; and it is possible to obtain pearlitic cast iron, low in carbon and high in silicon, with considerable ease. Owing to the very high temperature which can be maintained, the initial graphite is completely dissolved and its fine distribution in very small particles uniformly throughout the iron, is ensured on cooling.

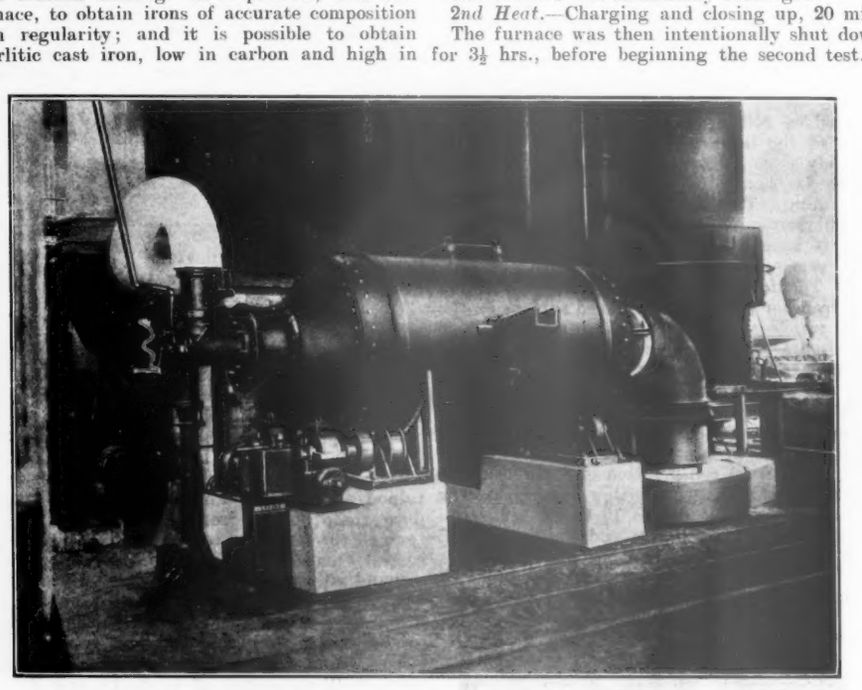

Fig. 7.—The Stein Oil-fired Rotary Furnace for melting Iron and Steel.

To give an idea of the oil consumption; starting with a cold charge of one ton, the metal can be melted and heated to 1,400 deg. C. on a maximum oil consumption of 16 to 17 per cent. by weight and up to 1,600 deg. C. on 18 to 20 per cent. The furnace has also a special use in large foundries for superheating the iron normally obtained from the cupola in order to obtain specially good-quality castings for such parts as cylinders and heavily-stressed mechanical parts. When melting malleable irons the consumptions are slightly increased.

The melting loss on these operations is 2 to 3 per cent., which takes place on the elements as follows:—Silicon, 13 per cent.; carbon, 5 to 6 per cent.; and the remainder, negligible. It should be noted that the final carbon content of the iron may lie between 3.2 and 2.4 per cent. It cannot readily be reduced below the latter figure. If the initial carbon is above 3.2 per cent. it burns away rapidly to this figure, and then slower, down to 2.4 per cent., at which amount the de-carbonisation practically ceases. The furnace lining is of "Silico"—a high alumina plastic material, of a composition suitable for the class of metal being melted, and the life of the lining for iron is approximately 100 heats.

Some particulars of actual tests carried out on these furnaces will, no doubt, be of interest. These figures were taken on installations in France, and possibly, therefore, do not exactly coincide with British practice. In the first, a ½-ton furnace was used for melting two heats of pearlitic engineering iron, and then, with a hot furnace, to melt a charge of steel for small castings. For the first two heats, the furnace was charged by hand with the following materials:—Mixed cast-iron scrap, 90 parts; steel scrap, 10; 45 per cent. Fe Si, 3; 80 per cent. Fe Mn, 0.25 parts. The iron was tapped at 1,580 deg. C. The times occupied were:—

1*st Heat*.—Pre-heating of empty furnace, 30 min.; charging, 25; heating, 50; tapping, 22; doors, opening, etc., 8 min.; total, 1 hr. 45 min.

The furnace was immediatly recharged:—

2*nd Heat*.—Charging and closing up, 20 min.

The furnace was then intentionally shut down for 3½ hrs., before beginning the second test.

Times for second heat:—Heating, 1 hr. 7 min.; tapping, 20 min.

3*rd Heat*.—The furnace was immediately recharged with the following material:—Fish-plates, 50 parts; horse-shoes, 50; charcoal, 2.5; 45 per cent. Fe Si, 2.5; 80 per cent. Fe Mn, 1.25 parts.

Times for the third heat:—Charging, 33 min.; heating, 1 hr. 25 min.

The temperature of the steel at the tapping spout was 1,680 deg. C., and it cast as easily as metal from a converter. The composition of the steel was as follows:—Carbon, 0.19 per cent.; silicon, 0.10; manganese, 0.10; phosphorus, 0.40; sulphur, 0.06 per cent. The high-phosphorus content is due to the use of fishplates high in phosphorus. The composition could be varied by slight modifications to the charge. The melting loss was 2 per cent.

The oil consumption for the cast-iron heats was 19½ per cent. and for the steel 28 per cent., giving fuel costs of approximately 12s. 8d. and 18s. per ton respectively. It should be remembered that this is a ½-ton furnace, and the consumption on the larger sizes would be lower. A further test, on a 1½-ton furnace, was carried out as follows:—Liquid iron was preheated in a cupola and introduced into the rotary furnace with cold additions of ferro-alloys, etc., for corrections, being superheated to obtain perfect homogeneity, solution of graphite flakes and a suitable casting temperature. The melting loss as determined was insignificant and the metal obtained perfectly sound in spite of the low-carbon and silicon contents employed.

After these tests were made, three further melts were carried out, starting with cold charges of 90 per cent. cast-iron turnings and 10 per cent. ferro-alloys and other additions. The metal temperatures obtained were 1,565 C., 1,613 C. and 1,614 deg. C., in times varying from 75 to 90 min., and the oil consumption between 14 and 17 per cent. of the weight of the charge. All the temperatures referred to were taken with a Simens & Halske disappearing-filament pyrometer sighted in the stream of metal at the tapping spout, in order to avoid errors due to sights taken on parts already covered with iron oxide.

The comparative costs in melting cast iron with oil fuel and with pulverised coal presents features of real interest. The figures are based on furnaces having a daily output of 6 tons, a 1½-ton Stein & Atkinson oil-fired furnace of the type just referred to and a 2-ton rotary pulverised-fuel furnace, costing respectively £900 and £1,700 complete. Oil is taken at 65s. per ton and bituminous coal at 18s. per ton.

Fig. 8.—Askam Rotary Iron-heating Furnace for superheating Cupola Metal.

The comparison, of course, varies according to the weekly output, but for a normal tonnage of 30 tons per week the oil-fired furnace shows an advantage of nearly 3s. per ton melted. At reduced output this advantage is even greater, amounting to over 15s. per ton melted at 10 tons per week output. The two costs are the same at 58 hrs. per week output, which would entail working two shifts; and such an output, if regularly required, would be better handled with a larger furnace working one shift. Even at 100 tons per week, which is the absolute maximum at which the furnaces could work 24 hrs. per day continuously, the advantage in favour of pulverised fuel is only 9d. per ton.

For normal foundry purposes the oil-fired furnace is clearly at an advantage, whilst in addition the capital outlay is much lower, and stoppages due to breakdown are less owing to the very much simpler mechanism. This same furnace can also be used for melting non-ferrous metals, such as bronze, the consumption of oil being less than 8 per cent. The time for melting on the 1-ton size charge from cold furnace on this operation is 1 hr. 10 min., and for subsequent charges 50 min., the metal loss on scrap charges being 1.25 per cent. and on ingots 0.75 per cent. The life of the lining when operating bronze is 400 heats.

Actual results obtained on a 1½-size furnace are as follow:—When melting turnings having a

(*Continued on page* 308.)

A Simplified Method of Manufacturing Special Brasses.*

Certain special brasses, especially those containing 5 per cent. nickel and 3 per cent. manganese, have a resistance to corrosion equal to that of bronze, but they have an elastic limit, a resistance to tension and an elongation, in round figures two times greater than bronze with 10 per cent. tin. They possess good forging and casting qualities, and further they are considerably cheaper: the cost price of such a brass, in equal weight, being from 15 to 25 per cent. lower than that of bronze containing 10 per cent. tin. For these reasons they are used extensively for machine castings, and for naval construction as screw propellers, etc., locks and fittings and other applications. In order that the remarkable qualities of these brasses may be obtained, it is necessary to have the proper proportions of copper, zinc, nickel and manganese, so that the "replacing" ratio of the alloy is constituted between 61/39 and 57/43, or better still between 60/40 and 58/42.

The "replacing" ratio as defined by M. Léon Guillet in 1905 is known to be based on the consideration that according to a certain rate of addition, the materials added to simple copper-zinc brasses give with these two an equivalent not unit for unit, but with certain coefficients:

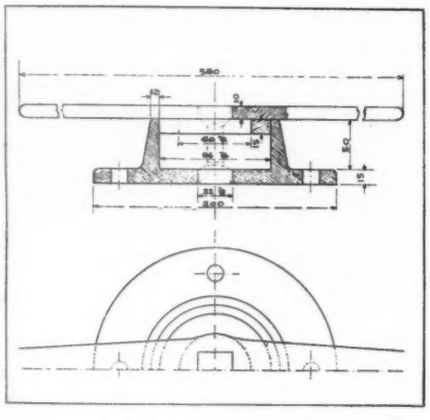

FIG. 1.—TORSION APPARATUS, DIMENSIONS IN MM.

for example, 1 per cent. of manganese is equivalent to 0.5 per cent. zinc, and 1 per cent. nickel is equivalent to 1.3 per cent. of copper. If, in analysing the alloy, the manganese content be replaced by its equivalent in zinc, and the nickel by its equivalent in copper, and the whole made into 100 parts, the "replacing" ratio will be found in copper and zinc.

Using the "Replacing" Ratio.

For example, if the analysis indicates 55 Cu, 36.8 Zn, 5.1 Ni and 3.1 Mn, the 5.1 Ni is equivalent to 5.1 × 1.3, which is 6.63 of copper, and the 3.1 Mn is equivalent to 3.1 × 0.5, being 1.55 of zinc, the "replacing" ratio in copper would be of 5.5 + 6.63 units for a total of 55 + 36.8 +6.63 + 1.55 units, being 61.63 for 99.98; in other words, 61.642 per cent.: the "replacing" ratio of brass would be within the limits indicated above for a good alloy of the type in question.

It should be noticed that these limits are not very wide. To ensure maintaining it so, it is essential every time an alloy has to be prepared to know exactly the analysis of the raw materials and to determine the calculation and regulate the proportions of these materials in the charge. These calculations are long and tedious, and it is seldom that the practical foundryman carries them out, whilst the manufacture of these special bronzes, so interesting on account of their mechanical properties, is itself a formidable and risky problem.

But by a very simple calculation, Mr. A. Le Thomas has shown that if an ordinary brass of known composition, for example C/Z and of an alloy rich in special elements of which the replacing ratio is C/Z, they can be mixed in all proportions and always with a final alloy of exact "replacing" ratio C/Z=60/40, this author has studied the alloys Cu-Zn-Ni-Mn rich in nickel and manganese with replacing ratio of 60/40. It can be imagined, or rather found out by an algebraical calculation to be infinity,

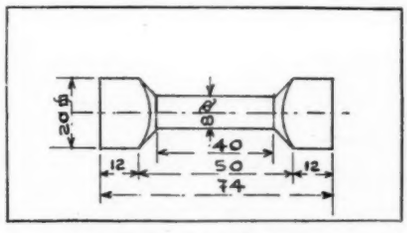

FIG. 2.—TENSILE TEST-PIECE.

leaving the best choice to be made, that is to say, the most convenient for preparation and use.

The most suitable is composed of 16.7 parts of Cu, 30 parts of Zn, 33 parts of Ni, and 20 parts of Mn; this is very hard and breaks easily when hit with a hammer. It definitely melts at 960 deg. C. and alloys easily with the brass 60/40, which itself melts at about 900 deg. C., so that the introduction of the elements of the alloy compound themselves, without having to superheat, and so avoid the zinc losses which might spoil the composition.

Use of Nickel and Manganese.

It should be noticed, then, that by using such an alloy the manufacture of special brasses of high strength is facilitated and simplified, and

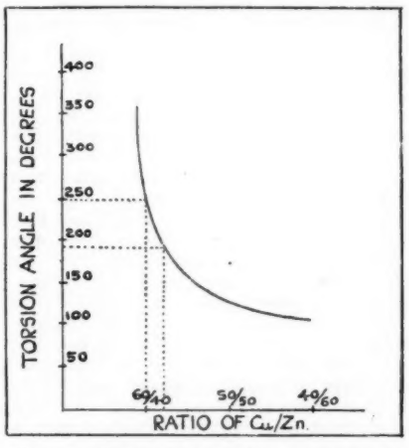

FIG. 3.—TORSION TESTING AS APPLIED TO BRASS ALLOYS.

for these the "replacing" ratio has much more importance than the absolute contents of each of the composing elements. The preparation of an ordinary 60/40 brass is easy, for the additional alloy, being rich in nickel and in manganese, can be prepared in quantity for use in several of the melts of special brasses. To emphasise the point, that its composition need not be that as strictly indicated above, the figures may differ somewhat provided that its "replacing" ratio calculated as shown above, to be composed between 61/39 and 57/43 or, better, between 60/40 and 58/42. Now, if 15 kilos of this alloy be added to 85 kilos of ordinary brass 60/40, the brass obtained would contain about 5 per cent. nickel and 3 per cent. manganese, and if the weighing were not done accurately that would not make any difference, since the "replacing" ratio will remain the same.

The runners, wasters and scrap from special brass returning to the foundry can be utilised in every proportion of the charge, their "replacing" ratio also being fixed between desired limits, the "replacing" ratio of the final alloy will remain suitable, without having to reckon the small differences of composition which may exist.

Melting Loss Allowances.

If the method which has just been shown offers a great simplicity and security—almost automatic—for the preparation of special brass with high strength, it should not be deduced that it renders all supervision useless. In the first place, through successive remelting of foundry scrap, it may happen that the losses through successive heats may make the "replacing" ratio vary; in this case a small addition of zinc is needed.

At the Indret dockyards, where this alloy is constantly being manufactured, two kinds of methods are used.

One is a rapid micrographic examination, made on a small quantity of alloy taken from the bath, the operations not lasting more than a few minutes.

The other method of operation, although not so quick, is much better for use in most foundries. It consists of a manual torsion test, using the very simple apparatus as shown in Fig. 1, and which can be made quite easily. Fig. 2 shows the test-piece using square heads, whilst Fig. 3 is a diagram of the angles of torsion working with the "replacing" ratio. It will be seen that for a "replacing" ratio varying from 60/40 to 58/42 the angle of torsion before rupture varies from 250 to 190 degrees; further, whilst the composition decreases, the angle of torsion rapidly increases. It is not necessary for the apparatus to have a complete graduation; a few reference marks suffice to assure that the alloy is well within the desired limits of composition for obtaining high strength properties.

* Résumé of an article which appeared in La Revue de Metallurgie, September, 1931.

Foundry Equipment, Limited.

This newly-formed company, which has its offices at 15, Victoria Street, London, S.W.1, is presided over by Mr. J. B. Corrie, the other directors being Mr. A. J. Baillot, Mr. A. S. Beech (manager) and Mr. A. G. Corrie. Mr. Baillot, who is well known as a designer and builder of foundry plant, is to act in a consulting capacity, but the company is not confined to taking or putting forward Mr. Baillot's suggestions, machines or schemes. It seems probable, however, that they will utilise his design of mould conveyors and sand-preparing plant. Actually, every nut and bolt will be of British manufacture. New types of moulding machines have been designed by British experts and are now being built exclusively for Foundry Equipment, Limited, by Messrs. Fielding & Platt, of Gloucester. Other equally well-known British houses are to manufacture the sand plant. A high-grade staff of specialists has been engaged and the activities of the company may be summarised under the following headings:—(*a*) Service of the highest order will be accorded to clients; (*b*) attention will be given to the creation of pattern plates and their appliances; (*c*) moulding boxes and snap-flasks of special design; (*d*) hydraulic electric and pneumatic moulding machines; (*e*) sand-preparation and reconditioning plant of unique design, and (*f*) continuous-casting plants complete in every detail.

Foundry Selling Practice.

WHERE ARE THE FOUNDRY SALESMEN?

By Eric N. Simons.

Quite recently, the head of one of the largest foundries in this country asked the writer the pertinent question: "Where, in my organisation, are the coming salesmen?" He was distressed because, as it seemed to him, among the numerous juniors that his firm were employing there was none that "jumped to the eye" as a likely lad to train up for salesmanship. Now the selling of castings "on the road" is not a job for anybody. And when that selling has to be carried on in distant countries like India and China, it is a difficult job for somebody. There was some excuse, therefore, for the perturbation of the questioner, because he shared the writer's view that a young man trained up in the shops and offices of his own foundry is better than any outside salesman purchased at a price, however brilliant his connection. It appeared, however, that suitable young men to receive such training were few and far between.

This particular foundry is a provincial organisation, and it is to some extent inevitable that a large percentage of its juniors should suffer from the worst forms of provincialism, which consist mainly of an excessively broad accent, and manners more adapted to industrial suburbia than, say, to the social life of Shanghai or Calcutta. There are a few public-school boys in this foundry, but some of them are guilty of that disinclination to study hard and put up with an inferior position for the time being that is a barrier to success in the technical world. Which was the better, the questioner wondered? To take a provincial youngster and strive to give him training and polish at the same time, or to take the public-school boy, with his polish ready made, and try to knock habits of hard work and study into him. Experiments have been tried with both types, and have been both successful and failures. One provincial boy, who went overseas, lost his head when brought into contact with a kind of life and freedom, to which he was unaccustomed, and had to be sent home. Another, though conscientious, struggled unavailingly against social inexperience and had to confess to failure. He never threw off his feeling of inferiority to those with whom he had to mix. On the other hand, one public-school boy, whose manners were flawless, was too sure of himself and his position to put in hard work, and excess of tennis soon led to his recall. Another was extremely well liked, but could not get orders.

The Type and the Job.

Successes have, nevertheless, been encountered with *both* types. One former public-school boy is sales manager to this foundry to-day, while a provincial day-school boy is manager of a large Dominion branch office, and doing well. This of itself should suggest that the answer lies *not in the type of school so much as in the type of man*. Given a boy who is prepared to work hard and study for technical salesmanship, who has had a decent home and a good education (whether public-school or secondary school), and who has likeable characteristics, and he can be made into a first-class technical salesman. The vexed question of public school or day school does not, therefore, invariably arise. It can be said at once that there are certain countries to which a public-school boy should certainly be sent as salesman if at all possible. One of these is India. If the writer were choosing a man, however, to cultivate the "Bazaar" trade of India, a public-school man is the last one should choose. It can be said with a measure of accuracy that on the whole the day-school boy, with his wider experience of social types, usually does better wherever races or nations different from his own have to be negotiated with on terms of comparative equality. The public-school boy acquires, willy-nilly, certain attitudes and prejudices, together with some inflexibility of ideas, that hamper him always in dealing with foreigners. Whether he likes it or not, the public-school man is unable to regard anyone who does not, for example, bathe frequently as a normal person, and this is bound to colour his relations with him, however tactful and gracious a person he may be. In dealing with natives and foreigners one has to be able to sink prejudices and get right under the other man's skin, so that he is not antagonised by any feeling of superiority.

Home Requirements.

Again, it is quite wrong to imagine that the public-school boy is invariably the best type of salesman for England. Much depends on the kind of business being cultivated. In Lancashire and Yorkshire it is very doubtful whether a public-school-trained salesman cuts much ice. It has to be remembered that buying in many of these provincial firms is done by day-school men, who, regrettably, have a habit of regarding a public-school accent as "swank." Wherever the buying is done by public-school men a similarly educated salesman will do well for the foundry. But, on the whole, the writer would prefer a *well-educated* day-school man for the rest, except, perhaps, in the South of England.

The point of *education* is stressed because it is perfectly true that the ordinary public-school boy who comes into commerce is, despite the cost of his education, far less *educated* than the day-school boy of the same age who has had a secondary education. The writer knows few public-school men in business to-day who do not have trouble with their spelling, who can state offhand the location of a particular foreign town, or who can speak a foreign language with fluency. Yet all these things are essentials in commercial education. On the other hand, the public school certainly does give qualities of initiative and assurance, the ability to wear a dress shirt without awkwardness, tact and polish, and a number of social contacts that may ultimately prove beneficial.

It should be clear from the foregoing that the first consideration in choosing the future foundry salesmen is *character*. The second consideration is the type of post that is open, *i.e.*, whether salesmen are required for home or for overseas, and in both cases what kind of business is being sought and what particular countries or districts are concerned. Assuming it to be possible, a proportionate number of secondary-school and public-school boys should be chosen for training. Those chosen should, of course, possess the right characteristics of enterprise, ambition, conscientiousness, honesty and intelligence. A certain minimum of social accomplishment is essential. The boy should be able to speak clearly and fluently, without too marked a provincial accent, and should know how to eat and behave in ordinary good company. The number of each type should vary according to the posts likely to fall vacant within the period of training.

Where are these young men to be found? Mostly, of course, in the drawing offices, the laboratories, the general offices, and one or two in the works offices. But in wise foundries an attempt will be made to engage boys from the outset less haphazardly than usual, and to pick the best from both kinds of school as they present themselves. The type of training to be given to them is the next important point, and this demands a special section. It is in the training received at the works that a salesman of castings is made or marred.

It is reported that a company is being formed for the production of a patent light alloy on the site of the old Cyfarthfa Ironworks at Merthyr. The alloy, which is held to be of great potentialities, has recently been undergoing tests at the Dowlais works of the British (Guest Keen Baldwins) Iron & Steel Company, Limited.

Spelter Prospects.

By "Onlooker."

It is not so many months ago that spelter seemed to be living right up to its reputation of being the "Cinderella" of the metal markets, for the price in sterling was somewhere about £10 per ton, which, in terms of gold, hardly bears thinking about! On all sides pessimism regarding the future was rampant, and it was impossible to find anyone with a good word to say for the metal, which, it was declared, was so much a by-product under modern methods of production that whatever the market price might be output would continue unabated.

Then the 10 per cent. duty was put on at the beginning of March, and almost immediately values began to strengthen, for there was no saving clause as to sales at world price, and Empire producers saw an opportunity to increase premiums which they were not slow in taking. Following on this came an agreement among Cartel members to cut production still a little more, as a result of which consumption came into line with output, and in due course as trade began to pick up slightly, surpassed it. Latterly there has been a very definite improvement in the statistical position, and stocks on both sides of the Atlantic have registered useful reductions.

While it is perfectly true that the American situation is divorced from the position on this side and the price in the States rules above the quotation here, there is nevertheless a sentimental effect which does influence to some extent values on our London Metal Exchange, and an upward swing in New York would certainly not pass unnoticed in Whittington Avenue. Spelter is nominally, at any rate, a free market, cartel prices for high-grade zinc being based on the mean of the London Metal Exchange spot and forward quotations, but it is certainly more restricted than it was before the 10 per cent. duty was put on, since imports of spelter into this country and sales to users here are virtually in the hands of one concern. Nevertheless spelter is in no sense a tied market in the same way as aluminium or nickel, the London Metal Exchange rules making it possible to buy and sell freely on any market day, and a study of price movements over the past few weeks shows clearly enough that there is plenty of elasticity in the arrangement.

Although activity in those trades using spelter is not by any means what it ought to be, there can be little doubt that an improvement has taken place both in the galvanising industry and among brass manufacturers. Nevertheless, stocks in this country are still very large and quite a fair proportion of the metal which was imported just before the duty went on is still available for sale to consumers, holders for the most part being prepared to await a further price appreciation. In most directions this is confidently anticipated and we are promised G.O.B. quality at £17 by the end of the year, but manufacturers with the evidence of many thousands of tons at different places up and down the country and a host of uncertainties, political and otherwise, have not so far strayed much from the path of hand-to-mouth purchasing.

At the time of writing market spelter is quoted on the London Metal Exchange at £15 10s. per ton (paper), the gold equivalent being about £10 8s. 6d., and it may be taken as reasonably certain that producers at the forthcoming Cartel conference are not going to take any steps to jeopardise this value, which is after all only moderately remunerative even to such a low-cost producer as Canada. Much more likely is it that every endeavour will be made to lift values higher and to this end their policy will be directed. On the whole consumers would be well advised to keep ample cover and not be too frightened of buying forward on any setbacks that occur.

Recent Developments in Mechanising Hull Foundry.

WITH SPECIAL REFERENCE TO CUPOLA CHARGING.

By Vincent C. Faulkner.

It must be about six or seven years ago since we had the pleasure in visiting the magnificent foundries of the National Radiator Company, of Hull. Since that time conditions have been reorganised to such an extent that little of their former characteristics remain, except the incessant search for enhanced quality and economic production. It will be remembered that this firm was founded in 1895 and works later erected in 1905, Hull being chosen as a suitable site on account of the export trade with Scandinavia, coupled with the facilities it presents for drawing upon seaborne traffic in pig-iron, coke and sand. Moreover, the city has co-operated in solving the problem of disposing of the 100 tons of core sand daily created in the fettling shops, by arranging for the filling-in of an obsolete dock.

The offices are modern, having been built in 1915; are well lit and, obviously, splendidly heated. On the ground floor is the purchasing department and general office and on the second the administrative offices and a well-laid-out showroom. Herein is shown all the various types of radiators, boilers, kitchen ranges and sanitary goods made by the firm and its associated companies. In this connection we were particularly impressed with the excellent matching which has been obtained between the enamelled cast-iron baths and the vitreous china lavatory basins and water-closets. We personally detest using a ceramic bath, as it fails to attain the temperature of the water contained therein. Thus, if our preferences are general, there is much ground for satisfaction in being able to match colours so perfectly when made from materials of such basically divergent characteristics. It is interesting to note that all of the lavatory basins and water-closets are of china. They cost a few shillings more than those made of earthenware, but their strength is shown by the fact that our chaperone was throwing half-inch spanners into them from a distance of 15 feet.

The Foundry Proper.

We candidly confess that a day in Hull is inadequate to assimilate the whole of the details of this immense works, and this account will contain no reference to the laboratories, pattern shops or vitreous enamelling, as time did not permit of their inspection. The size of the foundry can be gauged somewhat by the fact that it is 1,000 ft. long. Thus our article will be limited to a description of the manufacture of radiators on a mechanised plant which was put into operation last January, with passing reference to the making of boilers and platelike castings. In any case, additional description, at least so far as boiler castings are concerned, would soon be obsolete, as plans are well advanced to mechanise much further this section of the firm's activities.

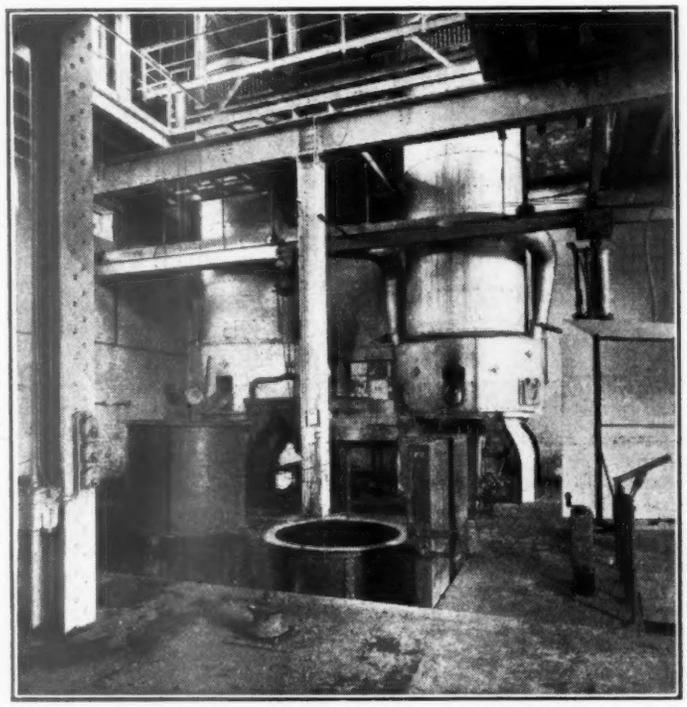

FIG. 1.—SHOWING THE WEIGHING BOGEY AND PUSH-BUTTONS FOR OPERATING THE CHARGER.

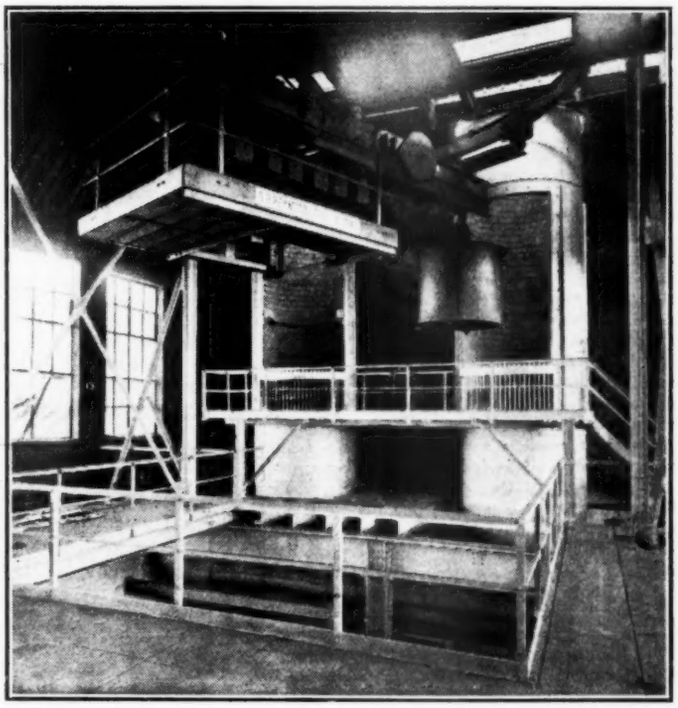

FIG. 2.—VIEW AT CHARGING LEVEL, SHOWING THE CHARGER ABOUT TO INSERT THE BUCKET INTO THE CUPOLA.

Cupola Charging Methods.

As a subject of keen interest to foundry engineers, we propose to describe in detail the methods and equipment employed to ensure a correct mixture that will satisfy the high-test standard demanded by the company, and the consistent delivery of molten metal required to supply the mass-production methods of moulding employed.

The lay-out of the yard is such that raw materials are brought in trucks from a siding off the main line and these are shunted to a position where they will shortly be used. Large stocks are not carried normally and such stock is not drawn upon in ordinary routine, as trucks of new materials are ordered forward as required. From the trucks ferrous material is taken by means of a magnet hung on the jib of a standard-gauge steam crane. It is then dropped into one or other of the bins reserved for it. Coke is wheeled in barrows from the truck by means of a gangway and deposited in its own bin.

The bins, eight in number, have floors at ground level, whilst a reinforced retaining wall at the back and similar dividing partitions separate the diverse contents. The divisions are not of equal size, but are arranged according to the nature of the material they will contain and each will hold at least three days' supply of that particular material.

Sunk in a trench approximately 5 ft. deep is a 2-ft. gauge-rail track, and on this travels an electrically-driven scale car capable of traversing the full length of the bins and continuing into the cupola house where it passes within 6 ft. of the outer or charging side of each cupola. The trench is of reinforced concrete and provided with sumps for drainage, while in a deep slot in one side are carried the bare conductors which supply current to the scale car.

The car is provided with a platform raised to ground level, and this is of a size to carry the reversing controller, the charge record and two men, either of whom may drive. Incorporated in the car is the weighing arrangement and this is novel in that there are two separate dial-type weighers, the dials of which indicate 10-lb. units, and the platforms placed end to end and sunk to such a level that the top of the bucket which stands on one or other of them is level with the ground.

Weighing at this point ensures that accurate record is kept of all material charged into the cupola, and since the total weight of each charge is the same and the individual weights of the various constitutents never vary, large pointers are clamped in the rim of the dial and marked for the various materials. Thus, sufficient pig-iron is loaded to bring the weigher-needle to the first pointer, then scrap till it reaches the next

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pointer and so on with each of the constituents. Amounts can be varied easily but for ordinary run the pointers are more clearly seen and mistakes prevented. The layers of material in the cupola will follow very closely the order in which the bucket is charged.

Only two buckets are used and the weights of these are taken care of by the tare beam situated under the dials. The arrangement requires the minimum of labour to operate, since the small pieces are never lifted more than a few inches nor thrown more than 4 ft., and two men load a bucket with a ton of material in three minutes. The weighing trolley is of their own design.

Buckets similar to those used in charging blast furnaces are employed. They are made of steel plate with seams riveted. The bottom consists of a cone from the apex, of which a bar ending in a loop forms the suspension point.

Separate from this is a plain cylinder provided with a flange round the top rim and normally resting on lugs on the periphery of the cone. It is this possibility of movement of the bottom relatively to the sides which permits the charge to slide through the annular openings, which increases as the bottom is lowered while the cylinder is sustained inside the cupola. The buckets will contain a 30-cwt. charge and weigh 13 cwts. empty.

In order to obtain the desired distribution of coke, it has been found preferable to charge this separately, but it should be noted that one factor contributing to this course is that the scheme allows ample time for it to be done.

The furnace house is a steel-framed building adjoining the wall of the main foundry and the spouts from each of the twin cupolas deliver metal inside the foundry. A glass roof is provided and ample ventilation arranged. At a level, about 6 ft. below the sill of the opening in the side of the cupola, a narrow walkway is provided but no provision is made here for the storage of materials, and in any event it would be impossible to charge from here.

The platform is served by a lift from the ground floor and is intended for the use of the cupola gang and the storage of their materials. A large opening is cut in the platform so that a man standing anywhere inside the building on the ground floor has full view of the charging doors.

The twin cupolas are 90-in. diam. shells capable of maintaining a maximum capacity of 20 tons per hr. They are made to the design of the company with drop-bottom doors. The cupola blower has a maximum capacity of 11,000 cub. ft. per min. with a total head of 30-in. W.G., this duty requiring approximately 85 b.h.p. A steel-plate fan is employed for this duty, driven through flexible coupling by a 100-h.p. motor at a speed of 1,440 r.p.m., so that fan scream associated with high-speed fans is obviated.

The design of the impeller is such that the required quantity of air is automatically delivered by the fan having a rising characteristic curve particularly suitable for cupola blowing and maintaining the specified pressure at any volume up to the maximum without pulsation or loss of efficiency.

Built into the brickwork of the lining and attached to the shell is a substantial cast-iron rest curved to fit against the brickwork, similar in shape to a wish bone of square section and such a size as to fit snugly around the charging bucket. It is this cast-iron rest which holds the cylinder of the bucket by supporting the flange, and no great load is ever put upon it. The inside diameter of the brickwork at charging level is larger than that of the melting zone and the dimension is reduced at a point just below the bottom of the door opening. Since this point would bear the brunt of the dropping charge the cupola is lined with five courses of special cast-iron bricks in this position and, as a consequence, the deterioration of brickwork from this cause is negligible.

A detail which will be seen from Fig. 1 is the grille which permits the man on the ground floor to see when his charge is kept at the required level. It serves to prevent overcharging and the risk of getting the bucket wedged inside the opening.

The openings in the cupolas are arranged radially to a point approximately 14 ft. away and midway between them, and this point forms the fulcrum of an elevated turntable of which the track is a straight piece of rolled-steel joist, the ends being attached to carriages. These carriages are supported at either end on a 4-wheeled ungeared trolley, which runs on the bottom flange of a curved rolled-steel-joist track permanently attached to supporting members in the roof of the building. It will be seen that the centre pin carries no weight and merely serves to centre the joist of the turntable which would otherwise float, due to its flexible attachment to its four trolley supports. A wall-mounted hand-winch of the wire-rope type serves to rotate the turntable until the joist is lineable with the centre of the opening of either cupola, and provision is made for locking it in that position. Since only one cupola is in use at any one time this movement is only done once a day.

It will be convenient to refer to this track on the turntable as the runway and since all loads are picked up at a position directly under the centre pin it is immaterial which cupola is in use. Needless to say, this point is vertically above the centre of the electric bogey track.

The machine which carries out the operation of charging the cupola is in effect a power-hoisting and power-travelling transporter, but differs in many ways from the normal article. Its design, construction and installation were entrusted to Messrs. S. H. Heywood & Company, Limited, of Reddish, and from the discussion held between the engineers of the two companies was evolved an arrangement which seemed to possess all the virtues.

The Charging Crane.

From Fig. 2 it will be seen that the framework of the charger consists of rolled-steel sections with an exceptionally stiff arrangement and provided with a jib at one end projecting several feet outside the long wheelbase, most of the weight being concentrated at the rear end.

In the forward end of the jib is carried an equalising pulley and two guide pulleys for the wire-hoisting rope so that the bottom block is carried on four parts which are widely spaced to obviate any tendency or twisting of the load or swinging as the bucket enters the cupola. Two parts of the rope are led over guide pulleys on to a grooved drum which is driven through a train of spur gears by an 18-h.p. electric motor, and controlled by a solenoid-operated brake of the caliper type. It is interesting to note that these gears are enclosed in cast-iron oil and dust-tight gearboxes so that their lubrication, silence and long lift is assured under all conditions of temperature. The rotor shaft has an extension to take the brake drum and the pinion, and is supported at its outer end on a Hoffmann bearing of a type similar to those used in the motor itself. The remainder of the shafts are "live" and revolve in grease-lubricated bronze bushes. The gearbox is split in the plans of these bearings so that accessibility is assisted. The brake is of most robust construction and has caliper arms of cast steel which support rocking shoes carrying the friction linings. The full load is lifted at 60 ft. per min.

The charger is travelled on eight single-flanged runners of cast steel, four of which are driven by a 3-b.h.p. motor through suitable reduction gear. A solenoid-operated brake is provided on this motion also. The travelling runners are particularly interesting in that they are fitted with the Heywood Patent axle which permits any one to be dismantled without removing any other part of the transporter or track, and in addition each is fitted with a double row of Timken tapered roller bearings so that endwise float is impossible and the outward thrust due to the slope of the joist flange is effectually countered. An adjustable roller runs on the underside of the track at the back of the transporter and prevents the jib dipping under the influence of undue weight. There is a platform on two sides of the transporter, the main purpose being to provide safe access for maintenance, but the transporter may be controlled by a driver as an emergency measure from this position. The speed of travel is 60 ft. per min.

It is in the electrical equipment that this charger differs so widely from others which charge in a similar way, for those others are usually controlled by a driver, whereas in this plant no driver is employed, and it is very probable that this elimination has not been effected by any other plant in this country.

Automatic Arrangements.

Mounted in a convenient position near the ground floor is an oil-immersed main-circuit breaker and three ironclad push buttons. One of these is "Stop" for use in emergency only. The second of these permits the bucket to be "inched" downwards from its position in the air on to the weighing platform, whilst the third is the working button, which also gives "inching" upwards within a distance of 4 ft. above the weighing platform. Once the bucket has travelled through a distance exceeding 4 ft. above the platform, pressure on the button is released, but the charger will now go through its cycle of operations without further attention.

The bucket is now attached and button pressed. The charger lifts to the desired height, *i.e.*, to a position where the flange of the bucket will be a few inches above the wishbone in the cupola, and travels forward till the bucket is directly inside the cupola It then lowers the bucket so that its contents are discharged, afterwards raising it and withdrawing from the cupola till it drops the bucket to a suitable height and there holds it until the "inching" button is used to set it down. The charger is arranged so that only one motor be in operation at one time, and, furthermore, an adjustable pause is allowed between the finish of one motion and the start of the next.

The motors are of the slip-ring induction type and, in order that acceleration shall be smooth and rapid, resistances of the patent Eddystat type are employed. This permits simple but robust contactor gear to be used for starting and the motor is thrown direct across the line in either direction of rotation. The motors, brakes, contactors and series limit switches are the only items of electrical gear in the main circuit, as all coils, limit switches, push buttons and selector relays are in a separate control circuit.

The main reversing contactors are made up separately for each motor and provided with forward and reverse push-buttons so that a driver on the platform has a complete and simple form of manual control from this point after cutting out the whole of the automatic gear by means of a three-pole switch.

Driven by bevel and countershaft from the rope barrel shaft are six Heywood's patent limit switches, each of which is separately adjustable. Of these, two are in the main circuit and will cut off current to the hoisting motor should the hook be lifted too high or dropped too low. These are emergency switches only, as the stopping at top and bottom limits is normally done by other switches when the bucket is at working levels. The automatic limit switches are arranged to work in conjunction with contactors in a selector relay panel and all are of Heywood's design and manufacture.

There are separate bottom limits at inner and outer ends, but the top limit is common to both, so there switches are employed, the sixth being a switch which ensures that travelling can be accomplished when the bucket is at top limit only. In addition to the limit switches are two

Heywood throw-over switches, operated by stops on the runway which ensure that when next the travelling motor is run it shall be in the reverse direction to that in use immediately before. The limit switches operate in conjunction with the selector relay panel in such a way that as one motion reaches its appointed limit it not only stops that motion, but permits a coil to be energised and contacts made which will allow the next motion to commence, and the time delay is controlled here by oil dash pots of a special non-leaking or clogging design.

It will be realised that the current passing through the switchgear in the control circuit is of the order of 5 amperes, yet the heavily-worked portions are designed to carry and break 60 amperes continuously, and in no case is the gear of less capacity than 30 amperes used. All wiring is carried out in single-core C.T.S. cable, run in cleats for easy access, and current is supplied to the transporter through slipper collectors and bare conductors stretched alongside the track.

Precautions have been taken to prevent immediate reversal of the hoisting motor by means of the up and down push buttons. If these are depressed one after the other at momentary intervals the load will ascend or descend in jerks according to which button was first depressed, but the contactor will not close to allow current to be applied to the motor in the opposite direction. The sight of this machine carrying out its duties untended is almost uncanny.

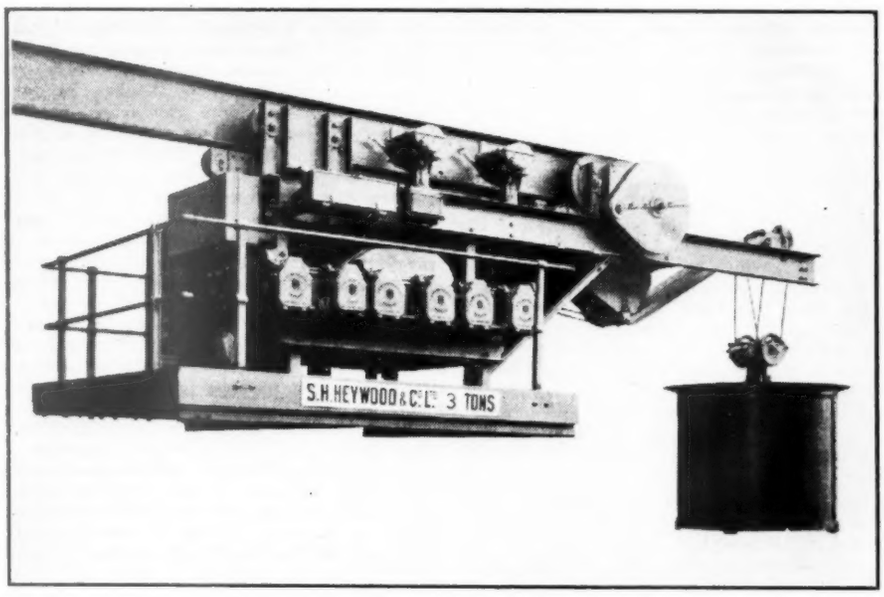

Fig. 3.—Showing a General View of the Charger.

Parts of the transporter, notably the jib ropes and bucket, will reach a high temperature towards the end of a day's work, but deterioration from this cause is negligible as though the bucket may enter the cupola and be surrounded by flame, the dumping of the contents soon quenches the worst of this. The time inside the cupola is only a fraction of a minute.

The margin and safety factor on the whole electrical and mechanical design has been such that in eight months' daily use it has not been necessary to employ for a single lift a driver on the transporter due to failure of the automatic control gear. In fact the only replacement has been wire rope due to deterioration from heat. Beyond Saturday maintenance of greasing and cleaning no work has been done.

In ordinary methods of charging, each piece of material is handled twice; here once is sufficient, whilst weighing is accurate and mixture uniform. Some mechanical charging arrangements possess the defect of piling on one side in the cupola together with damage to the brickwork. The National Radiator Company, Limited, have found that brickwork lasts as well as in a hand-charged cupola, and that since the charge is deposited higher round the walls than in the centre, the blast is better distributed and oxidation less, whilst coke consumption is not increased.

With old cupolas and methods fourteen men were continuously employed. These consisted of chargers, patchers, furnace-man and mixer at delivery spout, with a man to control the last and lend a hand with charging; all under the supervision of a foreman. This last position has been dispensed with; a total of seven men now give greater output of better metal.

On five days in the week the men start work at 6 a.m. and the blast put on at 7 a.m. Metal must be delivered inside the foundry at 7.25 a.m., and therefore tapping is continuous through a 9-hr. day. Speeds have been designed for 10 to 12 buckets per hour to be charged, so that there is considerable capacity available beyond the six buckets per hour which are filled at present.

The whole plant has been installed and bought at a cost of under £7,000, and much credit is due to the company for its courage and preparedness in these difficult times and to its engineers for the evolution of so satisfactory a plant.

Melting Plant.

The mixtures are melted in five cupolas of capacities ranging from 12 to 20 tons per hr. These are placed around the foundry grounds as two pairs and a single unit. In one case the slag is met by a stream of water, which granulates it for easy handling. At the discharge side of the cupola the metal runs into a tea-pot ladle mounted on trunnions. This ladle is tilted by the operator who controls the points of the monorails from which are suspended the actual pouring ladles, which, by the way, are also of the tea-pot type. Lip height is governed by the mechanism we described in connection with our article on Ferranti's plant.*

Radiator Plant.

It may seem Irish, but the best way of appreciating the modern mechanised moulding plant is to start at the "knock-out." The moulds which are coming off the reel at the rate of about one a minute each contain their quota of new sand and coal dust spread over their tops. They are picked up by an air hoist and dropped with a not inconsiderable bang on a grating, at any rate it is sufficient to rid completely the box and its castings from sand, and the box parts are returned to the reel. The castings are separated from the runners and stacked in light containers raised from the floor by four short legs. This permits of easy removal by electric- or petrol-driven runabout tracks.

The sand drops through the grating on a rubber belt conveyor serving six units or reels. It is a characteristic of this plant that there are no bucket elevators and every movement is effected by rubber conveyors.

The problem of steam generated along the knock-out conveyor has been very effectively solved by a simple yet powerful exhaust system leading into a pair of chimneys. The knock-out sand conveyor feeds a second rising conveyor which discharges into a rotary riddle. This frees the sand from metal and other contamination. The riddled sand falls on to a further belt which feeds a revivifier of the type which aerates the sand by high-speed vanes throwing it through a number of suspended rods. Periodically, a cam action jars this apparatus to free it from adhering sand. From the aerator the sand, whilst passing over a short length of conveyor, is tempered by water sprays, and further conveyors feed it into the two main storage hoppers—one for the drag and one for the cope machines. At the base of these are circular discharge plates, from which the sand, joined by a stream from either the spillage from the drag or cope machines is once again passed through an aerator of the type described above. From here the sand meets the main distributing conveyor band, feeding, by ploughing off, one of the two lines of machines, beneath which are trenches carrying the spillage conveyors. These discharge into other conveyors leading up to the aerator.

Moulding the Copes.

On the cleaned pattern plate a large number of wire chaplets are inserted in machined holes; the box part is taken from beneath the table of the reel and placed over the pattern. Then by hand a small amount of facing sand taken from a nearby barrow is spread over the top and bottom end of the radiator-segment pattern.

By operating a compressed-air-operated valve, a copious supply of sand falls on the pattern. After rapidly tucking in by hand, a ramming machine travels over the mould. Above the ramming machine is a shaft upon which are mounted a number of eccentrics to which are attached the ramming feet. Incorporated in these are rubber springs to prevent breakage if contact be made with the box parts. This ramming machine travels across the box twice; safety gadgets being incorporated to prevent operators being crushed in between the moulding machine and the ramming machine. For stripping, four little plates lift up the box, whilst at the same time the mechanism pushes up each of the wire chaplets. Air hoists are used to transport the box parts from the machines to the conveyor and for assembling the boxes. The speed of the conveyor is regulated by the cope machine, and all subsequent operations must synchronise. On the sixth unit or reel, castings other than radiator are being made in exactly the same manner except that ordinary power squeeze machines are being used, and for the shake-out the boxes are placed by hand on the grating, which is hinged and counterbalanced so that jars can be given by lifting and dropping.

Coremaking.

Sand is stored outside the core shop, and is taken by a rubber belt bucket elevator to a storage hopper inside the shop. From here it is fed into a mixer such as one sees engaged in road-making, but it is situated about 10 ft. from the ground. The oil and other ingredients

* Foundry Trade Journal, August 4, 1932, p. 65.

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are sprayed into mixer under pressure. Batches are emptied into containers suspended from the monorails and are distributed to the benches. Each bench has a knee-operated vibrator for facilitating stripping. The shell carriers are made from non-growth iron and are actually the drag part of the core box. The cores are arranged in tracks and transported to the stoves by electric or petrol-driven runabouts. For the smaller cores there are 20 coke-fired stoves controlled to give an oven temperature of about 200 deg. C. Though we failed to notice them there must be others to take care of the boiler core work.

Fettling the Sections.

Returning once more to the knock-out, the radiator castings are nested and transported by runabout cars to the fettling shop. The removal of the core sand is affected by suspending the segments from a short length of chain running in the direction to belt conveyor upon which are mounted at right angles a series of plates. As the sections pass along, matters are so synchronised that they bang against each of the plates. The sand drops below ground to be conveyed out of the works, where a bucket elevator fills one of the fleet of lorries engaged upon the removal of sand from the works. The sections are taken from the chain conveyor and are fed by chain drags beneath revolving scratch brushes. All sections are then tested at 100 lbs. per sq. in. for water-tightness, machined, assembled, re-tested at 100 lbs. per sq. in. and painted by dipping.

Other Manufactures.

Boiler sections about 4 ft. in diameter are being made by the sand slinger, utilising specially-designed stripping machines. There is a second mechanised plant for manufacture of the smaller fittings. It is of a simple character, as gravity-roller paths are used for transporting the moulds and the empty boxes. We wish to express our indebtedness to the technical staff of the National Radiator Company, and especially to Messrs. S. H. Heywood & Company, Limited, of Manchester, for the help given in the preparation of this article.

Catalogues Received.

Hydraulic Compression Testers and Presses.—List No. 330, issued by Sir W. H. Bailey & Company, Limited, Albion Works, Salford, Manchester, deals with (1) a hydraulic compression tester for ascertaining the strength of concrete, stone, earthenware and the like. The largest shown is of 200 tons capacity, and (2) hydraulic presses for the lecture-table experiments. One of these models appears to us to be suitable for testing the strength of dried cores; a 100-ton hydraulic press, and a useful 5-ton hydraulic jack.

Railway-Wheel Lathes.—We have from Messrs. Craven Bros. (Manchester), Limited, Reddish, Stockport, a copy of their publication NS10, which illustrates and describes a specially-designed lathe for the rapid machining of steel castings for loco wheel centres, carriage and wagon wheels, and the like. Steel founders should certainly furnish themselves with a copy of this pamphlet, as by the use of such modern lathes a modicum of profit can still be assured by the foundry.

It is officially announced that since August 1, 1931, when the present International Zinc Cartel came into being, the stocks in the hands of members of the Cartel have been reduced from 206,405 tons to 154,614 tons, or by 51,791 tons, representing almost exactly 25 per cent. The last three months show a total reduction of 13,163 tons.

Notes from I.B.F. Branches.

Middlesbrough.—The winter session of the Middlesbrough Branch of the Institute of British Foundrymen was opened on October 14, when a reception of members, their wives and friends was held in the Cleveland Technical Institute, Middlesbrough. The President, Mr. Sidney P. Thorpe, welcomed the guests, and in his address referred to the efforts of the secretary, Mr. Harper, who had arranged an exceptionally valuable programme for the session, dealing with practically all sides of the steel and cast-iron-foundry practice. He stressed the valuable work which the Branch carried out in dealing with the every-day problems which confronted foundrymen.

The Middlesbrough Branch was formed in 1926, with a membership of ardent workers of 40, and has made such fine progress that to-day, in spite of the difficulties of trade, the membership is 80.

The Branch had Papers delivered by most of the prominent men connected with the foundry industry, and undoubtedly each member who had listened to those Papers, and the discussions which followed, had personally gained knowledge which it was not possible to obtain elsewhere.

Speaking personally, the Institute had enlarged his knowledge of foundry work considerably, and he would always be grateful for being accepted into their ranks.

Sincerity combined with a desire to assist one's fellow-men gave one a pleasure in life which every person should try to acquire; the troubles of daily toil and the difficulties which arose at work, which every person in authority was continually encountering, were somewhat modified when one heard the discussions which took place at the Papers read in this Institute; it was then realised that, although a man may be burdened with troubles arising in his foundry, other people suffered the same, and invariably, if one cared to voice one's own opinion about these difficulties, a colleague would either suggest a way out of them or perhaps provide the solution.

A good deal of personal enjoyment was also obtained by associating with one's fellow-men employed in the same line of business, a friendly talk and discussion after the meetings often secured for one, sound and practical reasons for carrying out, or securing the best means of dealing with a difficulty, which one may have to face in practice. Everyone was not gifted with the powers of being able to express in public what they would wish, and therefore he personally tried to cultivate the friendship of the individual, which he found was most enjoyable and profitable.

Newcastle Branch.—A meeting was held on October 27, 1932, in the Neville Hall, when a Paper entitled "The Manufacture of the Mammoth Cunard Castings" was delivered by Mr. F. Swift, of Darlington Forge, the lecture being illustrated by lantern slides, some of which were reproduced in our issue of April 7, 1932. These castings, which were manufactured by the Darlington Forge Company, Limited, are amongst the largest steel castings ever manufactured in the British Isles, and the author was responsible for their production. Before giving his Paper, Mr. Swift said that he had a great respect for Newcastle-upon-Tyne, because in that district some of the most wonderful things in engineering and shipbuilding had been achieved. The Paper he was to give that evening was in the first place for the instruction of apprentices. The instruction of apprentices for a number of years had been uppermost in the minds of many of them, and he thought it was a pity that such a wonderful job as the Cunard castings should be allowed to pass without some record being made of it, and he would like them to give their opinion as to its suitability for the instruction of apprentices.

The discussion which followed Mr. Swift's lecture was very short, owing to lack of time. Mr. Scott, the Chairman, said that he felt rather bewildered; he had thought he was familiar with heavy steel castings, but after hearing Mr. Swift's Paper he realised his mistake. He would like to offer one suggestion, however. Mr. Swift had mentioned the lack of data on steel-foundry practice. He would like to see Mr. Swift's collection of photographs made into the form of a small book or pamphlet, as he thought they would make an admirable lesson on castings. The sectional drawing, in particular, was a remarkably fine one, and he had learnt more from that than from any other picture he had ever seen.

Mr. Swift was asked whether there had been any contraction on the castings. He replied that the contraction varied. On forty odd feet he imagined the normal contraction would be $\frac{1}{8}$ of an inch to a foot.

A vote of thanks was proposed to Mr. Swift by Mr. W. G. Paulin, and seconded by Mr. Scott.

Birmingham Coventry and West Midlands Branch.—The Birmingham, Coventry and West Midlands Branch held their first works visit this session on Thursday, October 20, when about 60 members were conducted over the works of the Austin Motor Company, Limited, at Longbridge. The foundry of this company has recently been mechanised, and many of its features were of unusual interest to the visitors.

For the production of grey-iron castings a continuous casting plant is used, the moulds travelling on a conveyor past a pouring point and afterwards passing along a ventilated tunnel, which collects the fumes from the moulds. At the end of the tunnel the moulds are taken from the conveyor and knocked out over a grating; the castings are allowed to cool off and are then passed to the dressing shop. The sand falls through the grating on to an endless belt, which delivers it to the sand-treatment plant. This plant removes particles of iron from the sand magnetically, and also mills, aerates and delivers it into hoppers situated above each moulding machine. Two mould conveyors are in use, one for cylinders and the other for cylinder heads and details.

In the steel foundry three converters of the Stock type are used for producing steel castings, and here the moulds are dealt with by the batch system, being delivered by roller conveyors from the machines to a pouring centre. After pouring they are knocked out over an open apron conveyor at floor level, which takes the sand and castings on to a vibrating grid. Here the castings are shaken free from sand, the latter falling through the grid and passing to another sand-preparing plant. The castings are then collected and passed on to the dressing shop.

In the foundry there is a very-well-equipped core shop, where the work is mainly done by girls, using hand-operated roll-over machines and metal pattern boxes, the cores being made from an oil-bonded silica sand. Green cores are set on racks, baked in batch ovens, cleaned, blackleaded, and gauged for assembly into the moulds.

After having visited the various shops the party was entertained to tea on the invitation of the company. In the absence of the Branch-President, Mr. J. G. Pearce, who had been called away on business, Mr. D. H. Wood warmly thanked the management for so generously opening their works for inspection. This vote of thanks was seconded by Mr. E. M. Boote, and heartily endorsed by all the visitors. Mr. G. W. Brown, the foundry manager of the Austin Motor Company, replied on behalf of the company.

Melting Losses in the Cupola Furnace—Manganese.

By Colin Duncombe Abell.

In melting in the cupola, which forms the most important means by which the molten iron is prepared for casting in the foundry, certain changes take place in the composition of the iron, resulting in the loss of upwards of from 5 to 10 per cent. by weight of the iron charged and a corresponding reduction in certain of the constituents of the iron. All the chief constituents, namely, carbon, silicon, sulphur, manganese and phosphorus, are affected, but to varying degrees, and of these the sulphur content is increased slightly, the phenomenon being described usually as "sulphur pick-up." Without going into the effect on the other constituents, the extent to which the manganese content is altered is important in that upon the amount of manganese in the iron the constitution of the iron, and hence its inherent properties, very largely depend. Manganese comes only second to the carbon in importance in this respect, the two elements being responsible between them for the so-called "inherent properties" of iron, and especially of the high-grade irons made from charcoal, cold blast and hematite pig-irons. The question of the effect of manganese in the so-called semi-steel mixtures, about which much controversy has grown, will not be dealt with here, since certain other factors come into play in these types of metal which do not have such a prominent part in ordinary cupola work, and are mainly a question of the temperature ranges being entirely different.

Briefly stated, the effect upon the manganese of re-melting must be traced to its origin in the iron when ores are smelted in the blast furnace. In this basic process the amount of manganese in the burden and its resultant *distribution* between the molten iron and slag in the hearth of the blast furnace affect the degree to which the sulphur is eliminated from the molten metal and the equilibrium between the two phases is largely a function of the critical temperature of the hearth and the composition of the slag. Research has established that the methods adopted a few decades ago in blast-furnace practice were responsible for the high-grade irons, such as charcoal irons, cold-blast irons, etc., though much of the recent practice adopted in order to obtain low total-carbon irons and the use of the hot-blast process to increase the thermal efficiency of the furnace, have resulted in the elimination of much of the older methods of working which, contrary to most views held to-day, were more correct as regards the inherent properties endowed in pig-irons by reason of their method of production. Summarising the results, one may say that only by employing a low hearth-temperature together with a relatively high content of alumina and magnesia in the slag can irons be made possessing the characteristic qualities of the cold-blast irons, which represent the relic of the older methods of furnace operation. *It was also found that the manganese distributed itself in such proportions that the percentage concentrations in the molten slag and iron were approximately equal, and in charcoal practice, such that that the concentration of the manganese in the slag was twice that obtained in the iron.*

Slag Silicon-Content and Sulphur.

On the other hand, upon remelting slag silicon-content and sulphur in a cupola furnace one is faced with the problem of a suitable slag to offset the decrease in the amount of the manganese in the iron. Usually in melting there is formed a siliceous lime slag, containing much combined ferrous oxide and manganous oxide, and possibly some dissolved ferroso-ferric oxide (magnetic oxide). The iron is unavoidably oxidised to a small extent in the hearth of the cupola to a mixture of ferrous oxide and ferroso-ferric oxide, which form what are termed solid solutions with one another, that is to say, they dissolve in one another in the same way that water dissolves in treacle or treacle in water, and form with the silica from the walls of the furnace and patching and the sand from the surface of the pigs, a silicate called fayalite, $FeO \cdot SiO_2$, this gives the slag its characteristic colour and accounts for the loss encountered. These cupola slags, containing such large amounts of ferrous silicate or fayalite, have a very low capacity for dissolving the sulphur as calcium sulphide, due largely to the fact that the calcium sulphide is insoluble in presence of much silica. At the same time a very peculiar factor makes its appearance, but one which is very well known to physical chemists, namely, that ferrous oxide, manganous oxide, and lime form a group of oxides where the presence of much lime prevents the replacement of ferrous oxide by manganous oxide and *vice versa*; that is to say, that whilst ferrous oxide and manganous oxide are chemically equivalent in forming silicates, viz.:—Fayalite, $FeO \cdot SiO_2$, and manganous silicate or rhodonite (sometimes called tephroite), $MnO \cdot SiO_2$, the presence of much lime prevents the manganese replacing the iron much more than it prevents the replacement of manganese by iron, and at the same time prevents the formation of the iron-manganese silicate in the cupola slag. When the lime content is comparatively low, owing largely to the necessity of obtaining a low-melting-point slag which can easily be flushed from the cupola and one which will not build up on the walls, the iron and manganese dissolve very easily, even at relatively low temperatures. Since most of the manganese in the iron is present as manganous sulphide, the remaining sulphur being ferrous sulphide, the solution of a part of the manganese in the slag causes an increase in the proportion of ferrous sulphide which tends to dissolve sulphur and form more ferrous sulphide; the presence of manganese inhibits this action in the original process in the blast furnace. It is possible to eliminate most of the additional sulphur picked up in the hearth and prevent the loss of manganese, at the same time stabilising the orientation of the primary graphite, by using a synthetic slag composed, according to one of the three types, as follows, viz.:—

CaO. Per cent.	SiO_2. Per cent.	Al_2O_3. Per cent.	MgO. Per cent.	
30.0	30.0	25.0	15.0	2nd class irons.
45.0	30.0	15.0	10.0	1st class irons.
45.0	35.0	15.0	5.0	1st class irons.

This could most easily be made by using dolomite and bauxite in the proper proportions, taking into consideration the composition of the ash of the coke. A characteristic analysis of the ash from every sample taken during six months at Low Moor, during 1929, and covering in all about ten different types of furnace coke from as many different sources, is as follows, viz. (about 50,000 tons of coke; the ash content of the cokes varied from 6 to 12 per cent.): SiO_2, 48.30 per cent.; Al_2O_3, 25.08; MgO, 2.80; CaO, 6.36; Fe_2O_3, 11.15; Fe, 7,81; P, 0.08; and S, 1.78 per cent. The proportions should be about 15 to 20 lbs. per 100 lbs. of coke used, to which is added about one-tenth or one-twelfth of its weight of bauxite, although the writer recommends using not less than a minimum of 90 to 100 lbs. per ton of metal melted.* What one loses in thermal efficiency is easily compensated for by the increased stability of the metal with regard to its inherent properties, and by using the proper proportion of blast to coke, and balancing the blast pressure carefully for different regions of the hearth zones, one may obtain equally as good melting efficiencies as before. The production of better metal is when all is said and done of more importance in every respect than the thermal efficiency of the furnace. The reader may observe in passing that this is practically what is done in the Corsalli process, where the cupola charges are "protected" from excessive oxidation by a similar manipulation of the slag, the type of metal being, however, vastly different to cast iron.

* This appears to be far too heavy to our mind.—Editor.

Watching Scrap Metal Imports.

By "Importer."

It is quite possible that our Customs officers are not, as individuals, possessed of natures unduly suspicious, but their profession makes them prone to query statements and probe beneath the surface of things. Especially is this the case, one must suppose, when something fresh is added to the list of dutiable articles, and in that event the past twelve months must have been fairly hectic ones for them.

The Ottawa schedules say nothing about a duty on scrap metals, and our vigilant authorities at the ports have no option, therefore, but to allow this material in free, but what they have got to do is to make sure that the stuff actually is scrap and not something liable to the protective duties agreed upon some months before the Ottawa conference took place. Manufactured brass and copper are subject to an *ad valorem* duty, and this means that a very big range of products in a variety of shapes and sizes are dutiable on entry into this country. No wonder that our Customs authorities are on the *qui vive* to watch out for any possible evasion of the tax and that they find it a little difficult to differentiate between metals new and old.

Quite a considerable quantity of scrap metal is imported into this country from the United States and the Continent, and although our departure from the gold standard has added to the difficulties of the foreign exporter, the flow has not been by any means stopped. From America come copper in various forms, such as heavy collected material, *i.e.*, old plate and sheet, etc., and copper wire usually free from insulation, while brass scrap commonly takes the form of old rolled, heavy brass or cut-up pipes and tubes. This class of stuff even to the unpractised eye has every appearance of grist for the foundry and could hardly be taken for semi-manufactured or manufactured articles, while it must be admitted that some of it is too obviously junk to require labelling as old metal!

The Continent sends all sorts of scrap into Britain, and some of it is causing the Customs people a certain amount of anxiety, for it looks too new to be old! Cartridge cases are an instance of this, for whether the material be what is known in the trade as "bright fired," or whether it be process scrap, *i.e.*, wasters made during the manufacture of the finished article, the appearance of the scrap is all against it. Actually, of course, such cases are quite useless for any purpose other than melting, and in the brassworks in the Midlands large quantities of both British and foreign cases are utilised in this way every year. Recently the suggestion was made that a cartridge case might be used as a pencil holder, but one can hardly imagine the public rushing to buy such a clumsy object! Shell cases of first-class brass quality are also shipped to England from time to time, and were this material left in its original form one can imagine a lynx-eyed Customs officer suspecting a shipment of dinner gongs or umbrella stands, but generally these cases are flattened before despatch to facilitate packing.

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This Week's News in Brief.

Trade Talk.

Messrs. Geo. Armitage (Leeds), Limited, iron and steel merchants, have removed to 8, East Parade, Leeds, 1.

The sale of the shipyard and engineering works of Messrs. Bow M'Lachlan, Paisley, which closed down some months ago, took place this week.

The Ealing Park Foundry, Limited, is being wound up voluntarily. The liquidator is Mr. F. E. Whitehead, 36, Basinghall Street, London, E.C.2.

A fire, believed to have been started by a spark from the furnace, at Messrs. Ryder Bros., iron-founders, of Black Street, Bolton, destroyed the timber of the 30-ft. hoist shaft in the moulding shop.

Messrs. William Wood & Sons, Lossiemouth, launched a motor-boat, the "Pansy," which has been built to the order of local owners. The vessel is fitted with two-cylinder semi-Diesel heavy-oil engines.

Messrs. Williamson - Buchanan Steamers, Limited, Glasgow, have placed an order with Messrs William Denny & Bros., Limited, Dumbarton, for a triple-screw turbine passenger steamer for service on the Clyde.

The London & North Eastern Railway Company has placed a contract with the Buda Company (England), of Wembley, for 37 rail motor trolleys, and with Messrs. D. Wickham & Company, Limited, Ware, for 16 rail trolley trailers.

The approximate production of iron and steel at the works of the Tata Iron & Steel Company, Limited, at Jamshedpur during September, 1932, was :—Pig-iron, 50,300 tons; steel ingots, 46,241 tons; finished steel, 36,800 tons.

The iron-ore shipments of the Swedish Grängesberg Company show a further decline to 138,000 metric tons in October from 190,000 in September. For the first nine months of the year the shipments aggregated 1,715,000 tons this year, as against 3,150,000 last year.

Messrs. Craven Bros. (Manchester), Limited, machine tool makers, so far this month have delivered two of their double heavy roughing lathes, one 60-in. centre heavy roughing lathe, and one "Buckton" 10-ton vertical single-lever testing machine, with motor drive.

Sir William Arrol & Company, Limited, of Glasgow, have received a contract from the Dublin Port and Docks Board for the construction of an electrically-operated bridge at the entrance to Custom House Docks, replacing the present swing bridge, at a cost of about £20,000.

We are informed that Mr. C. B. Unwin, A.M.Inst.C.E., late of the Chief Mechanical Engineer's Department, London Underground Railways, has been appointed assistant general manager to Messrs. Kryn & Lahy (1928), Limited, Letchworth, steel founders and engineers.

Messrs. Metal Industries, Limited, have bought for breaking up at their Rosyth yard the s.s. "Nethergate" from Messrs. Turnbull Scott Shipping Company, Limited, London. This is the first ship bought for breaking up for some months owing to the uncertainty of prices in the non-ferrous market.

Messrs. Kinnear, Moodie & Company, Glasgow, have received an order for a portion of the main drainage scheme of Swansea Corporation. Most of the tunnel in connection with the work will be constructed of cast-iron lining with the use of compressed air and hydraulic tunnelling shields. Lanarkshire works will benefit.

A contract for the supply of girders to be used in extensive bridge repairs and construction on South African railways has been secured by Messrs. Sir William Arrol & Company, Glasgow. The details of the contract are not yet available, but it is understood that it will keep the firm's girder shops employed at full pressure for several months.

Messrs. William Beardmore & Company, Limited, Glasgow, have booked an order for 12 high-speed commercial Diesel-engines for the Albion Motor Car Company, Limited, Scotstoun, Glasgow. Engines of this type have already been fitted on several omnibuses. The firm are exhibiting engines of this type at the Scottish Motor Show in Glasgow, where they are attracting much attention.

Messrs. Caledon Shipbuilding & Engineering Company, Limited, Dundee, have received an order to build a new passenger ship for Messrs. Alfred Holt & Company, Liverpool. The vessel, which will be about 315 ft. in length, will be used on the owners' service between Australia and the Straits Settlements. Propelling machinery, consisting of Diesel engines, will be built by Messrs. Burmeister & Wain, Copenhagen, and installed at Dundee by the builders.

The new coal-carrying steamer "Spray," built by Messrs. Hall, Russell & Company, Limited, Aberdeen, to the order of Messrs. Ellis & M'Hardy, Limited, completed successful trials in Aberdeen Bay. The vessel, which is 214 ft. long, is fitted with special arrangements for the rapid handling of cargo, and the propelling machinery constructed and installed by the builders consists of triple-expansion engines with two multitubular boilers working at 200 lbs. per sq. in.

The Delta Metal Company, Limited, of East Greenwich, recently endeavoured to manufacture an alloy having 55 per cent. of zinc and 45 per cent. of lead, for making into rods by extrusion, during which process the lead, which, of course, separated, cracked and was thrown about in a shrapnel-like manner, resulting in the death of one man and injury to several others. At the inquest on the dead man at Deptford last week, Mr. A. Topham (factory inspector) said that only about 2 per cent. each of the lead and zinc would alloy with the other, and the order was therefore impossible to fulfil. No one in the works realised this, but when the ingot was put into the press the metals in it must have been almost completely separated, like oil and water. The zinc came out perfectly in rods, then the lead, which was ejected with considerable force.

Personal.

Mr. Harry Buckley, a moulder in the employ of Messrs. Mather & Platt's works, Manchester, sustained a serious injury during the November 5 celebrations. As a result of an explosion in his house he had the thumb and first finger of his left hand blown off, and also had his wrist broken.

Mr. William Reavell, managing director of Messrs. Reavell & Company, Limited, engineers, of Ipswich, and a Past-President of the Institution of Mechanical Engineers, was unanimously re-elected President of the British Engineers' Association for the ensuing year at the annual meeting of the Association on Thursday, November 10.

Mr. Andrew Veitch, a director of the Frodingham Iron & Steel Company, Limited, and the Appleby Iron Company, Limited, Scunthorpe, has retired from the position of commercial manager to the two companies, after holding the position for 48 years. Much of his work has been taken over by Mr. A. Dick, of the United Steel Companies, Limited, of Sheffield, who has been appointed sales manager.

Wills.

Martin, Hugh, of Coatbridge, retired ironmaster	£23,601

Obituary.

Mr. Davis Green, managing director of Messrs. Lockerbie & Wilkinson (Tipton), Limited, engineers, has died at the age of 52.

The death occurred, at his residence in Merry Street, Motherwell, on November 12, of Mr. John Davidson, chairman and managing director of the Motherwell Waggon & Rolling Stock Company. He was 79 years of age and a native of Motherwell.

The death occurred in the Royal Infirmary, Glasgow, as the result of a motoring accident, on October 28, of Mr. James Lamb, of the melting department of Messrs. Colvilles, Limited, Dalziel Steelworks. Mr. Lamb had been in the service of the firm for over 40 years.

Mr. Joseph Fry Whitwell, who died in tragic circumstances recently at his residence, Langbaurgh Hall, Great Ayton, Yorkshire, was a well-known Tees-side ironmaster, being a son of the late Mr. William Whitwell, of Saltburn, founder of the firm of William Whitwell & Company, Limited, of which Mr. J. F. Whitwell was also a director.

New Companies.

Leeds Forge Company, Limited.—Capital £100. Solicitors: Linklaters & Paines, 2, Bond Court, Walbrook, London, E.C.

Machinery Experts, Limited, 48, Great Russell Street, London, W.C.—Capital £1,000. Directors: S Smith and A. E. Holmes.

Joseph Penn & Company, Limited, Providence Iron Works, Providence Street, Cradley Heath.—Capital £10,000. General engineers. Directors: J. S. and A. C. Penn.

Sankey Instone, Limited, 7-9, St. James's Street, London, S.W.—Capital £100. Engineers. Directors: Sir F. W. Johnston, Sir Herbert E. Morgan, S. Raben and E. Simmons.

Uniflow Products, Limited, 11, Queen Victoria Street, London, E.C.—Capital £10,000 in 5s. shares. Engineers and machinery manufacturers. Directors: F. Clare and B. Thompson.

G. S. Mottram & Partners, Limited, 15, Dumfries Place, Cardiff.—Capital £2,000 in £1 shares, to carry on the business of agents and representatives of any company factoring or manufacturing electrical apparatus and machinery, etc. Directors: G. C. Usher (director, International Combustion, Limited); G. H. Wilson and G. J. Scott (directors, Laurence Scott & Electromotors, Limited); V. Young (director, Mining & Industrial Equipment, Limited); G. S. Mottram (director, G. W. Mottram, Limited), and S. T. Lord. Secretary: S. T. Lord.

Company Reports.

Siemens Bros. & Company, Limited.—Interim dividend of 2½ per cent. on the ordinary shares.

Brown, Bayley's Steel Works, Limited.—Trading loss, £3,140; brought in, £7,900; carried forward, £4,760.

Drake & Gorham, Limited.—Net profit, £532; brought in, £3,294; dividend of 2 per cent., £2,500; carried forward, £1,326.

Guest, Keen & Nettlefolds, Limited.—Interim dividend for the six months ended September 30 at the rate of 5 per cent. per annum on the first preference shares, free of tax.

John Williams & Sons (Cardiff), Limited.—Profit, £6,571; brought in, £6,944; preference dividend, £1,500; dividend on the ordinary shares of 5 per cent., £3,798; bonus to staff, £675; machinery and plant account, £833; to special reserve, £100; carried forward, £6,609.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken

6,917. British Thomson-Houston Co., Ltd. Preparation of gaseous enveloping atmospheres for use in metallurgical operations. 380,428.

23,737. Gonschewski, H. Centrifugal metal-casting process. 380,576.

27,919. Carter Shock Absorber Co., Ltd., Carter, A., Badger, S. A., and Lees, J. Metal drawing, cupping, and like presses. 380,617.

30,310. Clark, W. R. Method of and apparatus for rolling metal. 380,642.

31,724. Rosenberger, F. Machine for casting metals and other materials under pressure. 380,644.

6,204. Croad, A. K. (Sand Spun Patents Corporation). Centrifugal machines for casting metals. 380,719.

31,600. Schloemann Akt.-Ges. Continuous mills for rolling metal rods. 380,293.

9,896. British Thomson-Houston Co., Ltd. Manufacture of rolled silicon-steel sheets. 380,387.

24,615. Süllwald, A. Production of highly-soluble basic slag. 380,143.

9,457. Crabtree, W. A., and Frakes, G. W. Presses for stamping or cutting and shaping articles of sheet metal. 379,697.

The modernisation of foundries

At this time next year you may be wishing that you had taken advantage of the slack time to prepare for the busy days which are soon to come.

Now is your chance to bring your foundry into line with modern ideas. Shortly you may be too busy to conveyorize.

A Morris foundry engineer will gladly come to discuss things with you, and his visit will involve no obligation whatsoever on your part.

It will cost you nothing to ascertain the facts from—

Herbert MORRIS Limited,

Loughborough, England.

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Raw Material Markets.

Business in the iron and steel markets continues to show a slight upward movement, but the general trend is rather disappointing, in view of what might have been expected, especially so when the continued lack of forward buying is taken into account. Lack of confidence among consumers, caused by a poor demand for their own products, is the chief cause of the latter failing. The export trade is developing on broader lines, owing to the combined effect of the fall in sterling and the rise in prices of Continental material.

Pig-Iron.

MIDDLESBROUGH.—The number of furnaces on Cleveland iron has now been reduced by three, owing to the reorganisation of the Skinningrove works. The output of Cleveland iron is now definitely below the demand, and the growing volume of inquiries should mean an early reduction of stocks. Deliveries to Scotland are increasing slowly, whilst local consumers have been making heavier purchases lately. Odd parcels continue to be sent abroad. Prices are unchanged. Special rates are quoted to Scottish buyers, but elsewhere the fixed prices, f.o.t. or f.o.b., are:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

Orders for East Coast hematite, while more numerous, continue to be on a small scale. The makers are anxious to book more forward contracts, but are unwilling to go far ahead at current prices, being convinced that an improvement in trade is impending. Recognised market rates are 59s. for East Coast mixed numbers and 59s. 6d. for No. 1 quality, but these rates are variable, according to the dates of delivery and payment.

LANCASHIRE.—Conditions remain unchanged in the consuming industries, with the exception of one or two special branches. The majority of users are still only ordering supplies over short periods, one or two favourably-situated works occasionally entering into forward contracts. On the whole, deliveries into consumption remain at about last month's average. Prices are steady on the basis of 67s. per ton for Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron, 65s. 6d. for Northamptonshire, 62s. for Derbyshire forge, around 83s. 6d. for Scottish No. 3, and about 81s. for West Coast hematite, all for delivery to works in the Manchester area.

MIDLANDS.—Slightly more activity has prevailed in connection with the demand for pig-iron, there being increases in both the volume of requisitions for immediate despatch and the number of forward contracts arranged. This access of business is almost entirely in connection with the makers of light castings, the heavy and general engineers being still very poorly employed. Current rates are 62s. 6d. per ton for Northants No. 3 and 66s. for North Staffordshire, Derbyshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—Business remains very limited; the majority of foundries are still pursuing a policy of day-to-day buying and their needs are generally very small. There are still only two blast furnaces in operation, but their output, together with the stock in hand, is ample with consumption at its present level. The makers still maintain Scottish iron on the basis of 67s. 6d. per ton for No. 3 foundry, f.o.t. furnaces, with 2s. 6d. extra for No. 1. Middlesbrough iron is in poor demand, the price being still around 55s. f.o.t. Falkirk, with other English foundry irons obtainable at about 1s. less. Continental material is non-competitive.

Scrap.

In the Cleveland area there is a slightly better demand for cast iron, up to 37s. 6d. per ton having been paid for machinery metal. Ordinary quality is still obtainable at 35s. per ton. In the Midlands, there is a slightly more active demand, but supplies are ample and prices are unchanged. The Scottish market remains depressed. In South Wales, also, conditions remain slow at the foundries, and their call for scrap shows no improvement. Heavy material is quiet at 39s. to 40s., with good machinery scrap at 39s. to 40s., per ton.

Coke.

It is impossible to perceive any improvement in the demand for coke, in spite of the fact that the makers are prepared to contract well forward at current rates. The present price for best Durham foundry coke is between 36s. 9d. and 38s., and for Welsh coke from 30s. to 45s. per ton, according to quality, delivered Birmingam and district.

Steel.

After a period of slackness the steel markets are becoming more active, although the improvement is slow, according to the official report of the London Iron and Steel Exchange. Continental competition is scarcely felt in the home market, and more export business has been done of late by British makers, although it has been confined principally to the lighter descriptions of material. Nevertheless, the outlook for the export trade has improved and greater confidence is apparent in the market. In the semi-finished steel department business has been quiet, partly because consumers are in process of adjusting themselves to the changed conditions resulting from the absence of the large offers of Continental material which have been a feature of the market for many years. British manufacturers are obtaining a fair amount of business, although the existence of heavy stocks in the hands of consumers has prevented this movement from developing. The demand for finished-steel materials has also become rather more active. Business in this department, however, has been irregular.

Metals.

Copper.—The demand for this metal is reported to have shown improvement, owing to the slightly better position at the consuming works. There has been a better call for refined metal, which has, however, fallen off slightly in the last day or two. The recent improvement was decidedly encouraging, however, if only to show that the market will make a quick response to any increase in the trade demand.

Closing quotations :—

Cash.—Thursday, £32 6s. 3d. to £32 7s. 6d.; Friday, £33 2s. 6d. to £33 3s. 9d.; Monday, £33 7s. 6d. to £33 10s.; Tuesday, £32 17s. 6d. to £32 18s. 9d.; Wednesday, £32 17s. 6d. to £32 18s. 9d.

Three Months. — Thursday, £32 10s. to £32 11s. 3d.; Friday, £33 6s. 3d. to £33 7s. 6d.; Monday, £33 12s. 6d. to £33 13s. 9d.; Tuesday, £33 2s. 6d. to £33 2s. 9d.; Wednesday, £33 2s. 6d. to £33 3s. 9d.

Tin.—The tin market has been distinctly firmer, following continued support from consumers. Both here and on the Continent the industrial demand has shown increased activity. In America, also, the market has improved, following the settlement of the Presidential Election. It is believed by competent observers that world consumption is at last on the up-grade.

Official closing prices :—

Cash.—Thursday, £154 10s. to £154 15s.; Friday, £156 5s. to £156 7s. 6d.; Monday, £156 17s. 6d. to £157; Tuesday, £156 10s. to £156 12s. 6d.; Wednesday, £156 2s. 6d. to £156 5s.

Three Months.—Thursday, £155 to £155 5s.; Friday, £157 to £157 5s.; Monday, £157 12s. 6d. to £157 15s.; Tuesday, £157 5s. to £157 7s. 6d.; Wednesday, £157 to £157 5s.

Spelter.—Quotations in this market rose in common with the prices of the other metals, but the rise was not based on any increase in trade demand. There is little possibility of the latter occurring until the galvanised-sheet market shows improvement. Stocks held by the producers showed a further fall during October, in spite of an increased production.

Daily fluctuations :—

Ordinary.—Thursday, £15 7s. 6d.; Friday, £15 12s. 6d.; Monday, £15 13s. 9d.; Tuesday, £15 10s.; Wednesday, £15 7s. 6d.

Lead.—The general position of this market remains unchanged, although there was a better call from consumers last week. Interest has since fallen off, however, while recent heavy arrivals of metal in this country have also helped to ease the market.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 8s. 9d.; Friday, £12 12s. 6d.; Monday, £12 13s. 9d.; Tuesday, £12 8s. 9d.; Wednesday, £12 8s. 9d.

British Work for "Conte di Savoia."

Clyde firms supplied a considerable quantity of equipment for the new Italian 48,000-ton passenger liner "Conte di Savoia" amongst which is 10 motor-driven induced-draft fans by Messrs. James Howden & Company, Limited, Scotland Street, Glasgow. The boilers are under balanced draft and the fans were specially designed for dealing with large volumes of gas and underwent special tests at Messrs. Howdens' works under the supervision of Lloyd's and The British Corporation.

Messrs. Cockburns, Limited, Cardonald, Glasgow, supplied 12 Cockburn-MacNicoll improved high-lift safety valves. Special steam-power-operated valves were supplied comprising two large chests with three valves in each; the weight of the two chests is 8 tons. In addition there were supplied two single steam-power-operated valves, the weight of the two being 3 tons. The 12 turbines were each supplied with Aspinall-Cockburn governors controlling the speed about 5 per cent. above the normal revolutions. The Aspinall-Cockburn governors work in conjunction with Aspinall-Cockburn-Scott forced-lubrication control comprising four Cockburn-MacNicholl emergency shut-off valves with oil-operating cylinders.

Messrs. G. & J. Weir, Limited, Cathcart, Glasgow, supplied two main steam-turbine-driven feed pumps of the two-stage barrel-casing type, each capable of delivering for normal load 250 tons per hr. and for maximum load 340 tons per hr. and designed to operate against a discharge pressure of 570 lbs. per sq. in. when supplied with steam at 340 lbs. per sq. in. There were also four Weir Lo-hed electrically-driven water-extraction pumps, four Weir closed-feed controllers of the float-operated type, ten Weir boiler-feed regulators each capable of passing 30,000 kilos of water per hr. when working at a boiler pressure of 448 lbs. per sq. in. The turbine blading and shrouding, the impellers and diffuser rings are of Monel metal.

Company Meeting.

Samuel Osborn & Company, Limited.

Mr. W. E. Osborn, chairman of Messrs. Samuel Osborn & Company, Limited, presiding at the annual meeting of the company in Sheffield, said that the directors' report did not differ materially from that of a year ago, the general trade depression having continued throughout the year. The preference dividend had not quite been earned, but, in view of the continued financial stability of the company, the directors felt justified in recommending its payment. He believed that the Sheffield industries, which maintained their reputation for quality, would recover when conditions were more favourable.

The Use of Fuel Oil in Foundries.

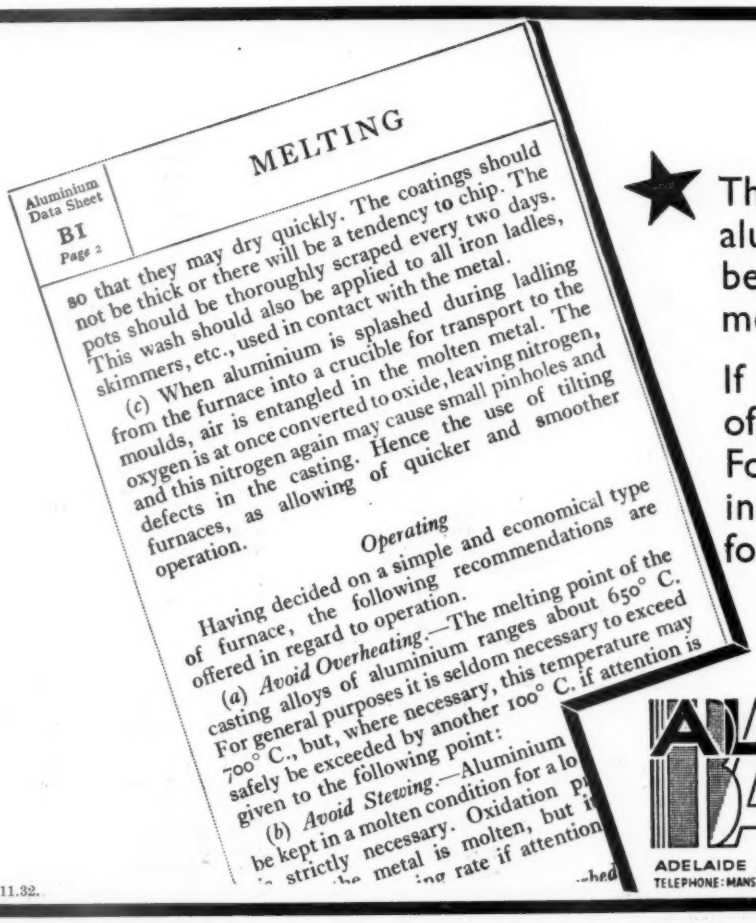
(*Continued from page* 298.)

final analysis of copper 83, tin 7 and lead 3 per cent., for casting into ingots at a pouring temperature of 1,350 deg. C., the figures were for heating up the empty furnace in 30 min., or 12¼ galls.

Three heats were run in a total time of 6 hr. 56 min., so that the furnace could melt 6 tons of turnings per day of 9 hr. The oil consumption after preheating averaged 5.8 per cent., representing a melting cost of only 2d. per 100 lb. of metal melted, or an overall figure of about 4s. per ton.

Another rather interesting furnace of a similar pattern is shown in Fig. 8. This is an Askam rotary iron-heating furnace for superheating cupola liquid to 1,400 deg. C. for making special castings, the oil consumption being 4 galls. per hr. This furnace is fitted with a low-pressure air-oil burner giving a wide angle flame, and the burner is disposed tangentially to the surface of the metal, so as to obtain a long rolling flame travelling down the length of the furnace.

(*To be concluded.*)


Aluminium Data Sheet BI Page 2

MELTING

so that they may dry quickly. The coatings should not be thick or there will be a tendency to chip. The pots should be thoroughly scraped every two days. This wash should also be applied to all iron ladles, skimmers, etc., used in contact with the metal.

(c) When aluminium is splashed during ladling from the furnace into a crucible for transport to the moulds, air is entangled in the molten metal. The oxygen is at once converted to oxide, leaving nitrogen, and this nitrogen again may cause small pinholes and defects in the casting. Hence the use of tilting furnaces, as allowing of quicker and smoother operation.

Operating

Having decided on a simple and economical type of furnace, the following recommendations are offered in regard to operation.

(a) *Avoid Overheating.*—The melting point of the casting alloys of aluminium ranges about 650° C. For general purposes it is seldom necessary to exceed 700° C., but, where necessary, this temperature may safely be exceeded by another 100° C. if attention is given to the following point:

(b) *Avoid Stewing.*—Aluminium
be kept in a molten condition for a lo
strictly necessary. Oxidation p
metal is molten, but i
rate if attention

ALUMINIUM AND LIGHT ALLOYS

THE BRITISH ALUMINIUM Co LTD.

ADELAIDE HOUSE, KING WILLIAM STREET, LONDON, E.C.4.

TELEPHONE: MANSION HOUSE 5561 & 8074 (5 LINES) TELEGRAMS: CRYOLITE, BILGATE, LONDON.

★ The technique of successful aluminium foundry work begins with the correct melting of the metal.

If you have not had a copy of B.A.C. "Aluminium Foundry Data," you are invited to write to us for one.

F.T.J. 17.11.32.

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CYLINDER

PIG IR

"The brand of proved rel

Supplied to specifications covering a wide range of requirements and employed by the leading Railway Co's Roll Makers and Engineering Founders.

WARNER &

CARGO FLEET

MIDDLESBROUGH

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	32 17 6
Three months	33 2 6
Electrolytic	37 15 0
Tough	35 0 0
Best selected	35 10 0
Sheets	65 0 0
India	46 0 0
Wire bars	38 5 0
Do., Dec.	38 5 0
Do., Jan.	38 5 0
Ingot bars	38 5 0
H.C. wire rods	40 10 0
Off. av. cash, October	31 18 7 1/4
Do., 3 mths., October	32 1 8 1/2
Do., Sttlmnt., October	31 18 8 1/2
Do., Electro, October	36 10 11 1/2
Do., B.S., October	34 15 0
Do., wire bars, October	36 18 1 1/2
Solid drawn tubes	10d.
Brazed tubes	10 1/2d.
Wire	7d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	7 1/2d.
Rolled metal	7 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£ s. d.
Standard cash	156 2 6
Three months	157 0 0
English	156 15 0
Bars	160 5 0
Straits	162 7 6
Australian	160 10 0
Eastern	162 0 0
Banca	163 10 0
Off. av. cash, October	151 7 6
Do., 3 mths., October	152 4 10 1/2
Do., Sttlmt., October	151 7 7 1/2

SPELTER.

	£ s. d.
Ordinary	15 7 6
Remelted	15 0 0
Hard	13 0 0
Electro 99.9	17 12 6
English	16 10 0
India	14 10 0
Zinc dust	22 0 0
Zinc ashes	2 5 0
Off. aver., October	15 0 1 1/16
Aver. spot, October	14 17 4 1/2

LEAD.

	£ s. d.
Soft foreign ppt.	12 8 9
Empire	12 17 6
English	14 0 0
Off. average, October	12 1 3 5/16
Average spot, October	11 19 2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 10 0
Do., V.M. ex-whse.	23 10 0
Rods	27 0 0
Boiler plates	23 0 0
Battery plates	—

ANTIMONY.

	£ s. d.
English	37 10 0 to 42 10 0
Chinese	27 0 0
Crude	19 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	10 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£13 15 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£20 0 0
Ferro-tungsten—	
80/85%	1/7 1/2 lb.
Tungsten metal powder—	
98/99%	1/10 1/2 lb.
Ferro-chrome—	
2/4% car.	£32 17 6
4/6% car.	£23 0 0
6/8% car.	£24 2 6
8/10% car.	£23 5 0
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£40 2 6
Max. 0.70% car.	£43 12 6
70%, carbon-free	1/- lb.
Nickel—80/99.5%	£250 to £255
"F" nickel shot	£226 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£100 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 3/16 in.	1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 1/2 in.	3d. lb.
Do., under 1/2 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales—	£ s. d.	£ s. d.
Heavy steel		1 18 6
Bundled steel and shrngs.	1 15 0	to 1 18 0
Mixed iron and steel	1 10 0	to 1 15 6
Heavy cast iron	1 19 0	to 2 0 0
Good machinery		2 5 0
Cleveland—		
Heavy steel		1 15 0
Steel turnings		1 7 6
Cast-iron borings		1 2 6
Heavy forge		2 10 0
W.I. piling scrap		2 2 6
Cast-iron scrap	1 15 0	to 1 17 6
Midlands—		
Light cast-iron scrap		1 15 6
Heavy wrought iron		2 5 0
Steel turnings, f.o.r.		0 19 6
Scotland—		
Heavy steel	1 12 6	to 1 15 0
Ordinary cast iron		1 19 0
Engineers' turnings		1 8 6
Cast-iron borings		1 10 0
Wrought-iron piling		1 18 6
Heavy machinery		2 4 0

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	25 0 0
Brass	16 0 0
Lead (less usual draft)	10 10 0
Tea lead	9 0 0
Zinc	8 10 0
New aluminium cuttings	72 0 0
Braziery copper	22 0 0
Gunmetal	21 0 0
Hollow pewter	82 0 0
Shaped black pewter	65 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	59/6
Hematite M/Nos.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	69/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	70/-
No. 3	67/6
Hem. M/Nos. d/d	67/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/- to 84/-
Clyde, No. 3	83/- to 84/-
Monkland, No. 3	83/- to 84/-
Summerlee, No. 3	83/- to 84/-
Eglinton, No. 3	83/- to 84/-
Gartsherrie, No. 3	83/- to 84/-
Shotts, No. 3	83/- to 84/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 0 0 to	9 15 0
Nut and bolt iron	7 15 0 to	8 7 6
Hoops	10 10 0 to	12 0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0 to	12 0 0
Bolts and nuts, 1/2 in. × 4 in.		12 5 0
Steel—		
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	8 7 6 to	9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5 1/2 in.		9 7 6
Rounds under 3 in. to 1/2 in. (Untested)	6 15 0	& up.
Flats—8 in. wide and over		8 12 6
under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 0 0
Hoops (Staffs)	9 10 0 to	10 10 0
Black sheets, 24g. (10-t. lots)		9 5 0
Galv. cor. shts.		11 5 0
Galv. flat shts.		11 15 0
Galv. fencing wire, 8g. plain		14 0 0
Billets, soft	4 17 6 to	5 7 6
Billets, hard	6 12 6 to	7 2 6
Sheet bars	4 15 0 to	5 2 6
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10 1/2d.
Sheet to 10 w.g.	11 1/2d.
Wire	11 1/2d.
Rods	10 1/2d.
Tubes	16 1/2d.
Castings	12 1/2d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.59
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.10
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
furnace	16/- to 17/-
Durham and Northumberland—	
foundry	21/- to 25/-
furnace	12/- to 12/6
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	15/9 to 16/3
	28×20 "	31/6 to 32/6
	20×10 "	22/7 1/2 to 23/-
	18 1/2×14 "	16/4 1/2 to 16/7 1/2
C.W.	20×14 "	14/-
	28×20 "	—
	20×10 "	—
	18 1/2×14 "	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Nov. 10 ..	32	6	3	dec.	11/3
,, 11 ..	33	2	6	inc.	16/3
,, 14 ..	33	7	6	,,	5/–
,, 15 ..	32	17	6	dec.	10/–
,, 16 ..	32	17	6	No change	

Electrolytic Copper.

		£	s.	d.	
Nov. 10 ..	37	10	0	No change	
,, 11 ..	37	10	0	,,	,,
,, 14 ..	38	0	0	inc.	10/–
,, 15 ..	37	15	0	dec.	5/–
,, 16 ..	37	15	0	No change	

Standard Tin (cash).

		£	s.	d.		
Nov. 10 ..	154	10	0	dec.	22/6	
,, 11 ..	156	5	0	inc.	35/–	
,, 14 ..	156	17	6	,,	12/6	
,, 15 ..	156	10	0	dec.	7/6	
,, 16 ..	156	2	6	,,	7/6	

Tin (English ingots).

		£	s.	d.		
Nov. 10 ..	155	5	0	dec.	20/–	
,, 11 ..	156	15	0	inc.	30/–	
,, 14 ..	157	10	0	,,	15/–	
,, 15 ..	157	0	0	dec.	10/–	
,, 16 ..	156	15	0	,,	5/–	

Spelter (ordinary).

		£	s.	d.		
Nov. 10 ..	15	7	6	dec.	1/3	
,, 11 ..	15	12	6	inc.	5/–	
,, 14 ..	15	13	9	,,	1/3	
,, 15 ..	15	10	0	dec.	3/9	
,, 16 ..	15	7	6	,,	2/6	

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Nov. 10 ..	17	10	0	No change		
,, 11 ..	17	15	0	inc.	5/–	
,, 14 ..	17	17	6	,,	2/6	
,, 15 ..	17	15	0	dec.	2/6	
,, 16 ..	17	12	6	,,	2/6	

Zinc Sheets (English).

		£	s.	d.		
Nov. 10 ..	24	10	0	No change		
,, 11 ..	24	10	0	,,	,,	
,, 14 ..	24	10	0	,,	,,	
,, 15 ..	24	10	0	,,	,,	
,, 16 ..	24	10	0	,,	,,	

Lead (English).

		£	s.	d.		
Nov. 10 ..	14	0	0	No change		
,, 11 ..	14	5	0	inc.	5/–	
,, 14 ..	14	5	0	No change		
,, 15 ..	14	0	0	dec.	5/–	
,, 16 ..	14	0	0	No change		

Imports and Exports of Iron and Steel Castings in October and the ten months 1932, compared with October and the ten months 1931.

	October, 1931.	October, 1932.	Ten months, 1931.	Ten months, 1932.	October, 1931.	October, 1932.	Ten months, 1931.	Ten months, 1932.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	995	164	11,260	2,399	13,899	2,883	146,428	42,131
Castings, in the Rough, Iron	15	9	1,179	550	328	181	23,766	9,937
,, ,, ,, Steel	655	77	5,262	1,456	19,665	1,143	108,274	28,419
Hollow-ware, Cast, not Enamelled	3	1	67	45	246	67	4,681	2,923
,, ,, Enamelled	2	3	48	199	152	77	2,641	5,530
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	25	5	711	286	771	179	33,184	10,624
,, Irish Free State	557	223	3,765	2,930	24,075	9,820	172,833	132,283
,, British South Africa	157	152	1,839	1,244	6,006	5,346	68,243	44,339
,, ,, India	71	58	1,107	687	2,697	3,400	40,283	25,643
,, New Zealand	21	22	306	283	993	1,156	18,973	14,945
Total (including other countries)	1,212	791	11,232	8,682	55,778	35,385	497,977	366,343
PIPES AND FITTINGS—CAST—								
To Argentine Republic	314	155	4,693	1,462	2,934	1,735	45,258	15,780
,, Irish Free State	602	537	11,616	5,565	9,774	5,948	134,498	75,782
,, British South Africa	464	191	6,548	3,158	4,089	1,968	75,261	39,455
,, ,, India	81	49	1,482	928	1,216	629	24,074	14,970
,, Straits Settlements and Malay States	163	285	2,392	2,157	1,379	2,119	25,530	21,520
Total (including other countries)	5,104	4,475	59,442	55,484	55,868	48,351	674,584	563,008
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	154	250	1,798	2,013	6,056	8,513	63,351	70,409
,, Enamelled	46	61	447	666	4,340	5,369	43,637	56,407
CASTINGS, in the rough—								
Iron	160	94	2,036	832	7,397	3,421	49,503	31,385
Steel	69	37	1,020	612	2,753	2,048	36,458	26,425

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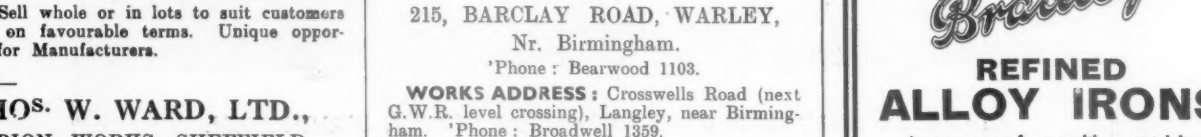

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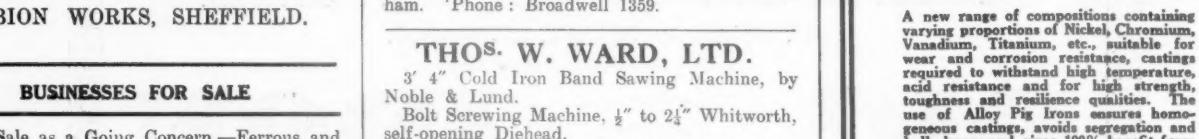
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